The Psychological Jitters

DURING the month of September, business and commercial men acquired a fine case of jitters. Now, jitters are psychological phenomena and they were made manifest in the actions of the stock market which did a fine flop.

The jitters were not the result of any one cause, but rather due to a number of causes. All stock market authorities have been flooded with requests to define the reason for the downward trend of stock values and the cause of the same, but there is no one cause.

World conditions, the exposition of the pirate tactics that were employed in the Mediterranean Sea, the break-down of all diplomatic negotiations for a settlement of the Spanish trouble, the total impotence of diplomatic efforts to stop the Japanese-Chinese trouble, the spectacle of a highly mechanized war-like nation, such as Japan, sending its war vessels into the Shanghai harbor without warning, demolishing the city, wounding, maiming and killing non-combatants and innocent civilians, and last, but not least, the effect of the appointment of Senator Black to be a Supreme Court Justice and the resulting investigations as to his ineligibility and the impotence of protestants to keep a man of his character off the Supreme Bench—all of these have conspired to produce a feeling of unrest and lack of confidence in the future of the Nation.

The brutal barbarism of the Japanese treatment of defenseless China was a distinct shock to the American public as it has been to every other civilized country. If Shanghai and Canton can be ruthlessly laid to waste without any declaration of war, might not the same thing happen to San Francisco and Los Angeles? And, if the League of Nations and the world's diplomatic agencies were powerless to stop the Japanese piratical invasion of China, what power could prevent the Japanese from extending their invasions to the United States or to any other country?

The appointment of Senator Black, the railroading of his confirmation through the Senate and the subsequent revelations of his disqualifications as a Supreme Court Justice and the impotence of the people in the United States to prevent his taking his seat, was the second great shock to the Nation's nerves.

It is no wonder that the country manifested its jitters.

However, jitters are psychological and like all psychological situations, they manifest themselves suddenly and disappear just as suddenly.

Nothing fundamental is wrong with business in this country except the uncertainty as to what the administration may do to further punish business for resisting some of its pet projects that have been turned down.

The outlook for fall business has not been better in years. The very day that the stock market had its worst session, the carloading of commodities for distribution throughout the country were the largest in seven years and the succeeding week saw carloadings go to 840,000 cars. This tremendous movement of freight—the largest since 1929—when taken into consideration with the tremendous movement of commodities by trucks, is one of the sheet anchors to the windward in the present situation.

The interests, which are affected by these psychological jitters, are by long odds in the minority in the country and they can and will recover their equilibrium. The facts are that at this writing, the general tone of business sentiment is definitely improving.

We still believe that the outlook for the last quarter's business is most encouraging and that the country, having gone through with this first big case of psychological jitters and seeing the needless loss incurred thereby, will not be guilty of a repetition for a long time to come.

+ EDITORIAL +

What Are You Doing with Welding?

MOST pulp and paper mills are users of welding equipment. Some of these mills have learned of the advantages of welding to economic plant operation and have extended its application to a wide variety of purposes. Some mills have only scratched the surface of application possibilities, while still others haven't as yet learned the first rudiments of its advantages.

To spread the gospel of welding, and primarily arc welding, is the function of The James F. Lincoln Arc Welding Foundation of Cleveland, Ohio. In fact, this Foundation has set up a fund of $200,000.00 to encourage the scientific study of arc welding and is seeking experienced data in the form of reports from all fields of industry. The fund is to be used to conduct an Award Program in which the authors of some 400 reports will receive individually a sum ranging from $100 to $13,700. Of course, these prizes go to the winners; but the losers win also in that the thought given to the preparation of their individual reports make each contributor just that much more expert in the subject. The management of every firm in which there is a participant likewise benefits in that savings will be made through better welding procedure; and the industry of which the author is a part is destined to gain from the information that will come from the increased use of welding in the industry.

The contest should prove particularly attractive to individuals associated with pulp and paper mills who have used welding to a limited extent or haven't used it at all. To such men is given the opportunity of developing the applications for welding and the contest is an incentive to do it.

If you as an engineer, master mechanic, superintendent or executive are interested in the subject of welding, consider the opportunity that the contest affords. Do not allow yourself to become discouraged by any of the common limitations that come to mind. Simply seek complete information from the Foundation; then go to work; and may success crown your undertaking.

Behind the Scenes of Business

THE 1937 revised edition of *Behind the Scenes of Business* by Roy A. Foulke, analyst for Dun & Bradstreet, Inc., offers a philosophical study of the essentials of profitable management that should be of interest to every pulp and paper mill executive.

The author comments, in part, that enthusiasm is a fundamental attribute of almost every successful operating management; that turnover of inventory is basically important; that the average, active man ends his business career when he is sixty-five years of age; that a business concern, to be consistently successful, cannot be operated in a general hit or miss manner; that as a business grows it invariably becomes a little more sluggish, slightly more bureaucratic, a trifle more difficult to handle, a little harder to keep in healthy financial shape; that on July 1, 1934, there were 1,973,900 active industrial and commercial concerns in the United States; that about 21¾ per cent of these concerns had a tangible net worth of $10,000 or more, approximately 6⅔ per cent at least $75,000, and only 2½ per cent greater than $500,000; that it is evident, nevertheless, that the greater part of the capital investment, sales, profits or losses, taxes, and employees, are concentrated with a moderate number of large corporations which comprise a very small percentage of all business units; and that the great majority of large corporations—business enterprises with a tangible net worth in excess of $500,000—which become financially embarrassed, arrive at that unfortunate final destination as a result of two basic policies: (1) carrying an excessive investment in fixed assets, that is, real estate, buildings, machinery, equipment, tools, furniture, fixtures, and leasehold improvements, and (2) incurring a top-heavy debt structure of current liabilities, or more often, of current and long term liabilities of various types and features.

It likewise is pointed out by the author that what is needed by business executives today as never before is a thorough fundamental understanding of the financial basis of successful business operations; that profit causes should be sought if the net profits of a business enterprise for a particular year are materially greater than those of all competitors; that the average life of a business enterprise is only about sixty-six months; that success in a highly competitive business world calls for a high degree of sustained physical and mental activity, courage, alertness, vision, shrewdness, and technical knowledge; and that business successes and failures are largely measures of managerial foresight or lack of foresight, ability or inability, hard-working or easy-going leadership.

Many of these comments are not new. Nevertheless, they are fundamental and a repetition of them should help to catalyze the productive activities of many leaders in industry.

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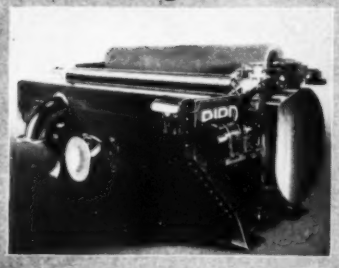

have you ever stopped to figure how much stock, time and trouble you could save by putting in a simple, gravity Bird Save-All system? . . . You can wash-up in less than half the time it takes you now and you can virtually put an end to losses of fibre, filler and color. . . . Ask us to work out the right recovery layout for your mill and show you how much it will save.

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The Function of an Advertising Agency

WILLIAM SIBLEY

ADVERTISING agencies as a fraternity, like railroads as an industry, are even yet damned by the malicious practices of a few forebearers. There were once a few railroads who publicly "damned the public." They were grasping capitalists who deserved all the whacks of the big stick Teddy Roosevelt could give them. But the sins of the few were visited upon the many, and so today railroads in general are still suffering from the mistaken judgment and avaricious intentions of the very few.

In like measure, there once were advertising agencies who bought bulk space from gullible newspapers, then "brokered" that space to clients at double the cost. Or, after soliciting an account and getting it, first asked the question: "How soon can we catch *The Saturday Evening Post*?" And so, because of the sins of the few, all advertising agencies have even yet visited upon their heads the approbrium of "racketeers."

But the advertising agency of today is as different from the agency of yesterday as is the Burlington Railroad of today different from the New York, New Haven and Hartford of fifty years ago. The modern agency is an institution from which is disseminated skilled information not only regarding advertising but merchandising, distribution, sales quotas, and business management. And this being true (a fact not enough admitted by many firms in need of sound agency advice) let me recite to you an instance wherein the function of an advertising agency, because it was unknown to a prominent paper manufacturer, has, up to the present time, kept that manufacturer from long sought profits.

Quite recently a man, now employed by a publisher, came into my office to be of service in his regular publishing capacity. But while here he fell to telling me of his interesting experiences as the advertising manager of a papermaking firm. The nubbin of his conversation had to do with a description of the development of an entirely new and amazingly successful packaging material—developed in the laboratories of the paper manufacturer where he formerly worked. This material—far superior to anything yet developed in the matter of porosity, moisture-proofing, eye appeal, economy, and other points—had been fully developed, it seemed, some six months ago. He, himself, had started and developed one large account which now is using this material for packaging its product. But beyond that single order, the plant executives were still jumping from cheese to cigarettes and back to bread or chewing gum—trying to find some manufacturer who would package their goods with this new material.

And, gentlemen, that work can so well, properly, and economically, be the function of an advertising agency.

If you have a new material, whether it be that of packaging food products or serving as insulation for commercial buildings—take your new development (after full protection has been secured through patent rights) to the advertising agency best equipped to serve you. Show them your product. Explain its merits. Submit your proofs of merit. Then tell them frankly that you are not so concerned with advertising it as in selling it. Could not the advertising agency take the exclusive sales rights to your new product (for a term of six months or so) and devise a sound merchandising plan covering it—offer it to some national advertiser—and by means of the product, as the excuse for the merchandising and advertising plan—get a new account for the house? The good advertising agency will do exactly that. And thereby benefit not only the manufacturer of the new product, but some national advertiser, and incidentally themselves.

Unless I have been grossly misinformed, that famous product Cellophane, gained its first great impetus through the services of an advertising agency. An enterprising agency, so I am told, took the idea of Cellophane packaging cigarettes to the Reynolds boys at Winston-Salem and so gave Camels a huge advertising-talking point over all other makes. (That is—until the other makes caught up with Camels by going "thou and doing likewise" to the large benefit of the duPont people). Whether or not that legend is factual, it none the less remains that such service can, and frequently is, rendered by advertising agencies—to the great benefit of developing manufacturers.

Since the majority of us are in the paper business, the majority of us can talk about packaging perhaps better than other products. All right—a new packaging material is best sold (and certainly most easily sold) when the product has been made a part of a complete merchandising plan. Under such a presentation you do not talk to the production manager, the purchasing agent, or the general manager—you talk to the president, vice-president, sales manager and advertising manager. And when, by virtue of a merchandising plan, you prove the value and profit that can come through the new packaging idea—your plan (and your product) is sold. That is one of the many functions of an advertising agency—a function too seldom sought by paper manufacturers who are constantly developing and producing new materials for all sorts of markets.

It is a function which proves mutually beneficial to all: the agency who uses the new product to gain a new and profitable account; the national advertiser who uses the new product and the merchandising plan to get ahead or keep ahead of competition; the product manufacturer who sells his product in larger volume, at a smaller sales cost than could be done otherwise.

ADVERTISING PAGES REMOVED

THE PAPER INDUSTRY
A MONTHLY EDUCATIONAL JOURNAL

What Colors Were Used in Dyeing This Paper?

E. R. LAUGHLIN
E. I. du Pont de Nemours & Company, Inc.

The purpose of this article is to serve as a guide to those in the paper industry who have need of a quick, simple and fairly reliable method for determining the dyestuff or type of dyestuff with which a piece of paper has been dyed.— *Author's Note.*

DYESTUFF identification is a subject requiring no little experience, as well as an intimate knowledge of dyestuffs and their application. The positive identification of a sample of unknown dyestuff is and should be a task for one of the dyestuff houses. The positive identification of every dyestuff used in a colored material such as paper, textile, leather, etc., is even more difficult and many times impossible because of the minute quantity of dye present in the material, and the masking of one dyestuff's reaction with that of another present. It certainly is no task for a layman, and it is not the intention of the author to offer the following remarks as any such positive identification scheme. On the other hand, any dyed paper will exhibit certain reactions to a few simple tests, which reactions may generally be attributed to the color present in the largest amount, i.e., the base color. Knowledge of this base color frequently explains special properties possessed by the paper such as light fastness, alkali fastness, two-sidedness, or the lack of these special properties. The obvious complexity of a minutely detailed analysis scheme, requiring as it would, the services of a highly trained analyst, would defeat the purpose of this article; whereas a half dozen one-minute test tube experiments which anyone can perform, will tell a significant story if rightly interpreted. It is, therefore, the author's thought to present these tests together with the necessary information for their interpretation in terms of the more important dyestuffs used on paper, and as a result of which anyone may, with reasonable assurance, answer the question: "What colors were used in dyeing this paper?"

There is, unfortunately, one obstacle with which anyone who writes on the subject of dyestuffs is invariably confronted, namely, nomenclature. To the chemist a dyestuff is a chemical individual of definite and easily represented constitution and structure, but to the consumer it may be known under a number of names generally prefaced by the manufacturer's trade name and followed by one or more distinguishing letters. It is true that in technical publications it is generally referred to by Color Index number, but this massive compendium of chemical structure and trade names is neither up-to-date nor generally available to those for whom this article is intended. Furthermore, any attempt to list all the trade names under which a dyestuff is offered to the trade would prove futile because of the number of sources of supply, and the necessity of ascertaining that each dyestuff from the various sources behaved exactly similarly in all tests. The author has, therefore, used the names with which he is most familiar, thus being certain that the listed reactions do occur. With few exceptions it is believed that prototypes of these colors will be found to react similarly.

For the purpose of simplicity the following tests pertain to *beater dyed sheets,* and the more important acid, basic, direct and pigment colors used in the

TABLE I—REDS

Dyestuffs	Class	1% NaOH	10% NaOH	1% H_2SO_4	10% H_2SO_4	10% HNO_3	Alcohol	Acetone	Dilute Hypo-chlorite	Hydro-sulphite
DuPont Rhodamine B	Basic	Bleeds	Bleeds	Bleeds	Bleeds	Bleeds	Bleeds	NC	15% dest.	Bleeds Part. dest.
DuPont Safranine T Ex.	Basic	Very sli. bleed	Mostly dest.	Bleeds	Bleeds	Dest.	Bleeds	Very sli. bleed (yellow)	Dest.	Dest.
DuPont Fuchsine Conc. Pdr.	Basic	Dest.	Dest.	Part. dest. (bleeds)	Dest.	Dest.	Bleeds	Bleeds	Dest.	Dest.
DuPont Brilliant Crocein FL	Acid	Bleeds some	Part. dest. (orange)	Bleeds some	Bleeds some	Dest.	Very sli. bleed	Very sli. bleed	Dest.	Dest.
DuPont Crocein Scarlet N Ex.	Acid	Bleeds sli.	Most dest. (bluer)	Bleeds	Bleeds	Dest.	Very sli. bleed	NC	Dest.	Dest.
DuPont Purpurine 4B Conc.	Direct	NC	NC	Blue no bleed	Blue-black, no bleed	Blue then dest.	NC	NC	40% Dest.	Dest.
"Pontamine" Fast Scarlet 4BS	Direct	NC	Part. dest. bleeds yellow	NC	NC	50% dest.	NC	NC	Dest.	Dest.
"Pontamine" Fast Red 8BL	Direct	Very sli. bleed	Violet	NC	NC	30% dest.	Sli. bleed	NC	40% dest.	Violet-then dest.

TABLE II—BLUES AND VIOLETS

Dyestuffs	Class	1% NaOH	10% NaOH	1% H_2SO_4	10% H_2SO_4	10% HNO_3	Alcohol	Acetone	Dilute Hypo-chlorite	Hydro-sulphite
DuPont Methylene Blue ZX	Basic	Dest., color returns on cooling	Dest.	Part. dest. bleeds	Part. dest. bleeds	Bleeds	Bleeds some	Very sli. bleed	70% dest.	Dest.
DuPont Methyl Violet NE	Basic	Slowly dest.	Dest.	Mostly dest.	Dest.	Dest.	Bleeds	Bleeds	Dest.	Part. dest.
DuPont Anthraquinone Blue B	Acid	Bleeds	Bleeds	Bleeds violet	Bleeds violet	Part. dest. bleeds pink	NC	NC	Dest.	Bleeds violet
"Pontacyl" Violet S4B	Acid	Dest.	Dest.	Dest.	Dest.	Dest.	Bleeds	NC	Dest.	NC
DuPont Soluble Blue R	Acid	Red—then dest.	Red—then dest.	Slight bleed	Some bleed	Dest.	Some bleed	NC	Dest.	NC
"Pontamine" Violet N	Direct	NC	Grad. dest.	Bluer no bleed	Bluer no bleed	Immed. dest.	NC	NC	Slowly dest.	Dest.
"Pontamine" Brilliant Violet B	Direct	30% dest.	Dest.	NC	NC	70% dest.	NC	NC	20% dest.	Dest.
"Pontamine" Blue BBN	Direct	Redder very sl. bleed	Mostly dest. (violet)	NC	NC	Dest.	NC	NC	Dest.	Part. dest.
"Pontamine" Sky Blue 6BX	Direct	Redder bleeds	50% dest. bleeds redder	NC	NC	Dest.	NC	NC	Dest.	Dest.
"Pontamine" Deep Blue BH Conc.	Direct	Very sl. bleed (violet)	Mostly dest. (violet)	NC	NC	Dest.	NC	NC	Slowly dest.	80% dest.
*DuPont Paper Blue S (Prussian Blue)	Pigment	Dest.	Dest.	NC	NC	Greener	NC	NC	NC	Dest.
Ultramarine	Pigment	NC	40% dest.	Dest. odor H_2S	Dest. odor H_2S	Dest.	NC	NC	NC	NC
"Halopont" Blues and Violets	Pigment	Dest.	Dest.	NC	NC	Dest.	Bleeds	Sli. bleed	NC	NC

*Confirm by iron test.

beater will be considered in groups classified according to hue.

Description of the Tests

The paper under examination should be cut into small pieces, approximately three-quarters of an inch square. For each test a piece is folded once and placed in the bottom of a six inch Pyrex test tube, just covered with the reagent to be used, and heated over a flame until the reagent boils. After one minute from the time the reagent boils the observations are noted with reference to the following:

1. Bleeding of color into the reagent. The color may leave the paper to a greater or less degree and color the reagent. This should be noted with respect to degree.
2. Destruction or partial destruction of color. This should also be noted with respect to degree. In some instances the color will be completely destroyed, in others only partially. If the color leaves the paper completely and colors the reagent, this is not considered destruction, but bleeding, since the color is still present.
3. Color change in the paper or in the reagent. This is perhaps the most important observation because nearly all papers are dyed with at least two colors. Some reagents will destroy or extract one color and leave the other unchanged in the paper.

The reagents used are:

1% sulphuric acid
10% sulphuric acid
1% sodium hydroxide
10% sodium hydroxide
10% nitric acid
ethyl alcohol
acetone
Dilute hypochlorite solution containing 0.2% available chlorine
15% sodium hydrosulphite solution

Both the hypochlorite and hydrosulphite solutions must be freshly prepared. This is particularly true of the latter which is not stable for more than a few hours.

Interpretation of Results

A little common sense is the quality most needed for the successful application of these tests. Attention must be given to the depth of dyeing, that is, whether it is a light, medium or a very deep shade. A deep shade will naturally give more bleeding than a light one; also color destruction proceeds more slowly with deep shades. It is, therefore, a good plan to use more paper and less reagent for light shades and vice versa for deep ones. Furthermore the degree of sizing must be considered. More bleeding and quicker destruction will be found in unsized sheets such as blotting, because of better penetration of the reagent. It is, of course, to be expected that in some instances the reactions of the base color will mask the reactions of a shading color sometimes present in considerable amount. Nevertheless in the majority of instances, even the shading colors may be detected unless present in very small quantities. Some attention must also be paid to the brightness of shade, the possible furnish, and the type of colors expected in consideration of these items.

In the following tables the notations are believed to be sufficiently clear except for the term "NC" which means no change, i.e., no bleeding, no destruction and no color change. In those instances where a color is mentioned in the notation, it refers to the color change in the paper and not in the solution unless otherwise specified. It is important to remember that more than one color is likely to be present, and in comparison of the reactions on the unknown and the tables, the thought of what combination of colors will produce the reactions of the unknown must be kept uppermost. Where confusion arises the bleeding tests should be temporarily rejected and attention concentrated on the acid, alkali, hypochlorite or hydrosulphite tests which cause color destruction. This will definitely eliminate many colors and when the rest are considered in terms of bleeding or color change, the correct solution may generally be reached *(See Table I)*.

Remarks: As a general rule, the sulphuric acid tests will differentiate between direct reds and acid or basic reds in red papers, Purpurine being easily identified by its characteristic blue reaction, and the other direct reds by non-bleeding. Profuse bleeding in alcohol indicates basic reds. Of these Fuchsine is identified by its profuse bleeding in acetone, while Safranine and Rhodamine may be differentiated by the nitric acid test. In browns, oranges and violets the identification of red shading agents is more difficult *(See Table II)*.

Remarks: A great many cheaper blues and violets are produced with Methyl Violet shaded with Methylene Blue or Victoria Green. The presence of Methylene Blue is indicated by bleeding in 10 per cent nitric acid, since both Methyl Violet and Victoria Green are destroyed by this reagent. Methyl Violet is only partially destroyed by 15 per cent hydrosulphite, whereas, both Methylene Blue and Victoria Green are completely destroyed. Although these three colors behave similarly on all other tests listed, they may generally be differentiated by those mentioned above.

Direct blues are the most difficult to identify. They are readily differentiated from acid, basic and pigment blues by the acid and alcohol tests, but determining which direct blue has been used in a shade is no easy task. Conclusions must be drawn from the degree of destruction with hypochlorite and hydrosulphite, and from color reactions with alkali.

Identification of the color used in tinting a white or very pale blue shade is difficult but not impossible. At least the class of color may be determined. Those colors most used are:

(a) Basic blues and violets.
(b) Acid blues and violets.
(c) Basic color phosphotungstates or "Halopont" Blues and Violets.
(d) Ultramarine.
(e) DuPont Paper Blue S (Prussian Blue).

(f) Vat blues or violets like "Ponsol" Blue RP Triple Powder. These are used only in very high grade whites—usually rag content.

A shading red such as Rhodamine or Soluble Carmine is often employed but the identification of this is not so important as the class of blue or violet with which most of the tinting was done.

Color reactions of tinted whites are not significant, nor are bleeding tests because of the small amount of color present. Conclusions must be drawn from tests employing reagents which will or will not cause complete color destruction.

The first test should be dilute hypochlorite. If the color is destroyed an acid or basic blue or violet is indicated. The hydrosulphite test will differentiate.

Note: *It is important to judge the results of the hydrosulphite test before the paper is removed from the solution. Otherwise the color, if destroyed, is likely to return upon exposure to the air.*

Continuing with the identification of tinted whites, if the color is stable to hypochlorite and destroyed by hydrosulphite, either a vat color or Prussian Blue is indicated. One per cent caustic will destroy the latter and not affect the former. If, on the other hand, the color is stable to both hypochlorite and hydrosulphite, it is either a "Halopont" type or Ultramarine. The latter is destroyed by 1 per cent sulphuric acid and is stable to 1 per cent caustic, while the "Halopont" type is destroyed by the 1 per cent caustic and stable to the 1 per cent sulphuric.

As an aid in determining whether the color has or has not been destroyed in the tests on tinted whites, it is well to immerse a piece of the paper in cold water and make comparisons against this as a control.

In shades other than whites in which the use of DuPont Paper Blue S (Prussian Blue) is suspected, it is well to conduct an iron test as follows: This test is very reliable if carried out carefully. Moisten a small piece of the paper in a test tube with cold 10 per cent sodium hydroxide. After a few seconds the color will be destroyed if it is Prussian Blue, and the excess caustic should be decanted from the paper and rejected. Next add 2 or 3 cc. of 15 per cent sodium or potassium thiocyanate solution, shake the tube well and add 2 cc. of conc. hydrochloric acid. If Prussian Blue is present both the solution and the paper will turn a distinct pink or red, depending on the amount of color present *(See Table III)*.

Remarks: No attempt has been made to distinguish between Orange II and Orange RO. These colors, often used in combination, are very closely related chemically and there is nothing to be gained by differentiating between them in an analysis.

Many brown shades on cheaper grades of paper are produced with either Chrysoidine or Basic Brown as a base and shaded with Methyl Violet and Victoria Green. The simplest method of identifying the base color in such a case is by the alcohol or acetone test. Chrysoidine bleeds profusely in both reagents and Basic Brown does not bleed at all. Some allowance must be made for the bleeding of the Methyl Violet and Victoria Green or other basic shading agents, but it is nevertheless relatively easy to determine whether the base brown does or does not bleed. Of course, if the base is a direct brown, this may be ascertained by acid and alkali tests.

Chrysoidine and the acid oranges are very nearly similar in all reactions but one, namely the 1 per cent

TABLE III—ORANGES AND BROWNS

Dyestuffs	Class	1% NaOH	10% NaOH	1% H_2SO_4	10% H_2SO_4	10% HNO_3	Alcohol	Acetone	Dilute Hypochlorite	Hydrosulphite
DuPont Chrysoidine GN	Basic	80% dest.	80% dest. bleeds yellow	Bleeds	Bleeds	Dest. bleeds yellow	Bleeds	Bleeds	Dest.	Mostly dest. bleeds yellow
DuPont Basic Brown BR	Basic	30% dest. yellower	60% dest. bleeds sli.	Bleeds	Bleeds	Dest. bleeds yellow	NC	NC	Mostly dest.	Dest. cold
DuPont Orange II Conc. and Du Pont Orange RO	Acid	Bleeds excessively	Bleeds excessively	Bleeds excessively	Bleeds excessively	Dest.	Bleeds excessively	Bleeds	Dest.	40% dest.
"Pontamine" Fast Orange EGL	Direct	Bleeds sli.	(Green) Bleeds sli.	NC	NC	NC	NC	NC	NC	40% dest.
"Pontamine" Fast Orange ERL	Direct	Slowly turns violet	(Violet) Bleeds sli.	NC	NC	NC	NC	NC	NC	Violet—then dest.
"Pontamine" Fast Orange MRL	Direct	NC	NC in color bleeds sli.	NC	NC	NC	NC	NC	NC	Dest.
"Pontamine" Fast Orange WS	Direct	Bleeds	Bleeds excessively	NC	NC	NC	NC	NC	Dest.	80% dest.
"Pontaimne" Orange R Conc.	Direct	Redder	Redder	Blue	Blue	Blue—then mostly dest.	NC	NC	70% dest.	Dest.
"Pontamine" Brown N3G	Direct	NC	Redder	NC	NC	40% dest.	NC	NC	Mostly dest.	Dest.

TABLE IV—GREENS AND BLACKS

Dyestuffs	Class	1% NaOH	10% NaOH	1% H_2SO_4	10% H_2SO_4	10% HNO_3	Alcohol	Acetone	Dilute Hypo-chlorite	Hydro-sulphite
DuPont Victoria Green SC	Basic	Dest.	Dest.	Dest.	Dest.	Dest.	Bleeds	Bleeds	Dest.	NC
"Pontacyl" Green BL Conc.	Acid	Dest.	Dest.	Bleeds very sli.	Mostly dest.	Dest.	Bleeds	NC	Dest.	Dest.
"Pontamine" Green BX	Direct	Mostly dest.	Dest.	NC	NC	50% dest.	Very sli. bleed	Bleeds some	Dest.	30% dest.
"Pontacyl" Blue-Black SX	Acid	Bleeds	Bleeds	Bleeds some	Bleeds	Mostly dest. bleeds pink	Bleeds some	Bleeds some	Dest.	NC
DuPont Nigrosine WSB	Acid	Bleeds dull violet	Dest.	Bleeds some	Bleeds some	40% dest. bleeds some	NC	NC	Dest.	Mostly dest.
"Pontamine" Black E	Direct	Greener bleeds sli.	Greener bleeds sli.	NC	NC	Dest.	NC	NC	Dest.	50% dest.
Paris Black	Pigment	NC	Bleeds some	NC	NC	NC	NC	NC	NC	NC

and 10 per cent caustic test by which they may be readily distinguished.

Perhaps the most widely used direct orange in higher grade papers is Fast Orange WS. It is characterized by stability to 10 per cent nitric acid, although destroyed by dilute hypochlorite. Very few colors behave similarly in this respect.

"Pontamine" Orange R Conc. is frequently used to shade Purpurine 4B Conc. yellower. It is practically impossible to distinguish between these two colors except for the fact that one is an orange and the other a red. Consequently, the shade of the paper must be considered *(See Table IV)*.

Remarks: Identification of the greens in green and blue-green papers should offer no difficulty. A green produced with a blue and yellow may generally be

TABLE V—YELLOWS

Dyestuffs	Class	1% NaOH	10% NaOH	1% H_2SO_4	10% H_2SO_4	10% HNO_3	Alcohol	Acetone	Dilute Hypo-chlorite	Hydro-sulphite
DuPont Auramine Conc.	Basic	Dest.	Dest.	Dest.	Dest.	Dest.	Bleeds	Bleeds	Dest.	Bleeds some, but not dest.
DuPont Metanil Yellow Conc.	Acid	Bleeds	Bleeds	Bleeds bluish-red	Bleeds bluish-red	Violet cold bleeds yellow	Bleeds	Bleeds	Dest.	Part. dest.
DuPont Quinoline Yellow Conc.	Acid	60% dest. bleeds some	60% dest. bleeds some	Bleeds	Bleeds	Slowly dest.	Bleeds	Bleeds	Dest.	Bleeds some. but not dest.
DuPont Brilliant Paper Yellow Conc.	Direct	Red bleeds orange	Red bleeds orange	NC	NC	NC	Bleeds	NC	Red then dest.	Dest.
DuPont Stilbene Yellow G Conc.	Direct	Bleeds some	Red, very sli. bleed	NC	NC	NC	NC	NC	Prac. NC	Dest.
"Pontamine" Fast Yellows NNL-BBL	Direct	NC	NC	NC	NC	NC	Bleeds some	NC	Prac. NC	NC
"Pontamine" Yellows SXP-SXG	Direct	Sli. bleed	Orange bleeds	NC	NC	NC	NC	NC	Prac. NC	Dest.
"Pontamine" Yellow CH Conc.	Direct	Sli. bleed	Sli. bleed	Bleeds some	Dulls no bleed	20% dest. bleeds some	Bleeds	Bleeds some	Bleeds some	NC*
Chrome Yellow	Pigment	Bleeds	60% dest. bleeds some	Bleeds some	70% dest.	Dest.	NC	NC	NC	NC

*Gradually destroyed in unsized papers such as blotting.

discerned by close observation of the color reactions during the tests, since some will destroy the yellow, others the blue component.

In grays, Nigrosine is best distinguished from direct black by the 10 per cent caustic and sulphuric acid tests. In deep blacks, a little more than one minute should be taken for the tests. Basic color shading agents frequently used in deep blacks may be extracted with alcohol and their amounts estimated. Furthermore, the presence and amount of Paris Black is readily found by the following test: Boil the paper in a strong hypochlorite solution. All colors normally used to produce a black will be destroyed except Paris Black *(See Table V)*.

Remarks: Metanil Yellow and Brilliant Paper Yellow are, of course, notoriously sensitive to acid and alkali, respectively. In high grade bond papers canary shades are sometimes produced by a mixture of Brilliant Paper Yellow and Quinoline Yellow, and some green shades by a mixture of these yellows and a blue. The best test to ascertain Quinoline Yellow in the presence of Brilliant Paper Yellow is boiling hydrosulphite. The latter is quickly destroyed, while Quinoline Yellow is not. If the paper is turned red by alkali, and if on a separate test hydrosulphite does not completely destroy the color, the presence of another yellow with the Brlliant Paper Yellow is assured.

The differentiation of the other direct yellows is often difficult. Their presence is established by stability to hypochlorite and they may be divided into two groups by their reaction to hydrosulphite. These groups, containing Stilbene Yellow G and Yellow SX in one case and Yellow CH and the Fast Yellow NNL type in the other, offer considerable resistance to further breakdown. Stilbene Yellow G turns redder with alkali than Yellow SX, but in some shades it is almost impossible to tell them apart. In deep shades Yellow CH may be distinguished from the Fast Yellow NNL type by some bleeding in acetone and 10 per cent caustic. Otherwise a stronger hydrosulphite solution, practically saturated and containing a little caustic must be used. On prolonged boiling (2 to 3 minutes) the Yellow CH will be destroyed.

In conclusion it should be stated that the above tables were prepared after testing the individual dyestuffs dyed as self colors in the laboratory using 2 per cent size and 2.5 per cent alum. In cases where confusion was likely to arise, mixtures were made and the reactions noted. This was then followed by a thorough testing of a wide range of commercially made papers on all furnishes, the dye formulas of which were known. The results were quite satisfactory. Greatest difficulty will likely be encountered on very light shades, and on blotting papers, but with a little care anyone should be able to tell the principal colors used in almost every instance.

Protection of Record and Exhibit Material Against Light

NUMEROUS inquiries are received by the National Bureau of Standards relative to the best practice for the illumination of libraries, art galleries and museums, so as to minimize the well known deteriorative effect of light on reference and exhibit materials. This has prompted the following resumé of some of the information available.

Investigators at the Bureau have found that on exposure of each side of various grades of papers to direct sunlight for a period of 100 hours, from 25 to 63 per cent of the original folding endurance was lost, and furthermore that the high grade papers were affected as much as those of relatively low quality. Other investigators have reported similar findings, and it is known that paintings, textiles, leather and other documentary and exhibit materials are subject to deterioration by light.

The Bureau has recommended that the effect of sunlight be minimized as much as possible by diffusion of the light with suitable window glass or with curtains over windows, and the use of incandescent lamps with lead-glass bulbs for direct lighting. The ultra violet rays are known to be particularly harmful, and glasses are available which exclude most of these rays. Tests by the National Bureau of Standards of some glasses of this kind showed that they excluded most of the ultra violet rays. As the result of an investigation of the protective effects of glasses of various colors, conducted by the Swedish Bureau of Standards, the use of lemon-yellow glass in libraries was recommended.

The following information was received from a depository of rare manuscripts, books, and paintings:

"In view of the investigations already made and the amount of information already available on the deteriorative effect of the rays at the extreme end of the spectrum, we could tell pretty well what rays we wished to eliminate as far as possible. Our greatest difficulty was to find a glass or electric light bulb that would cut off all the damaging rays, yet not distort or influence in any way the true colors of the materials on exhibition. We have used a cathedral amber actinic glass in our reference room where no rare material is kept, but this does not prevent fading entirely. We have blocked up the windows in our main exhibition room as well as in the rare book stacks, and are now using indirect artificial lighting for general illumination, and lead-glass bulbs of low wattage where direct lighting is necessary. We could, of course, use orange-colored bulbs in the stacks, but the efficiency of the illumination would be materially decreased. We are now working on the intensity of the damaging rays in the stacks under the present lighting conditions (60-watt white lead-glass bulbs) with the thought of estimating the deteriorative effect over a long period of years."

Identification of
Fibers Other Than Wood
Used in Paper Manufacture

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ALTHOUGH the raw materials which are consumed by the paper manufacturing industry may be traced to a great variety of sources, they are almost without exception of vegetable origin. The paper materials most commonly encountered are derived from the woody tissue of broad-leaved and coniferous trees. A description of the native pulpwood fibers was presented by Harrar and Lodewick in THE PAPER INDUSTRY for February, May, and August, 1934, and this article is intended as a sequel to their work comprising an enumeration of the microscopic features valuable for the identification of the non-woody fibrous materials which are used in the production of paper.

It is not the author's intention to describe the anatomy of the many plants which contribute fibers of economic value nor to offer a compilation of the voluminous published data concerning the properties or characteristics of multicellular fibers. The term *fiber* as here used refers to an individual cell type and it is in this condition that a pulp or paper sample is revealed under the microscope. Almost all semblance to the original plant tissue is lost in the pulping process and the individual cells of which the plant body was composed appear as isolated units. A knowledge of the structure of plants, however, is fundamental to an understanding of these different types of cells many of which possess diagnostic value.

All of the important plants with which this article is concerned are members of the phylum known as the *Angiosperms*, that very large botanical group which is represented by such common plants as milkweed, the grasses, hazelnut, and the maples. This group numbering about 150,000 species of plants is divided into two sub-phyla, the *Monocotyledons* and the *Dicotyledons*, the former possessing one seed leaf while the latter bears two. The Monocotyledons are represented by plants such as grasses, lilies, and palms with parallel veined leaves; the Dicotyledons, by plants of the flax, aster, or poplar type with net veined leaves. Herbaceous plants as well as trees or shrubs are included in both of these groups. The differences between Monocotyledons and Dicotyledons are not restricted to such external features but extend to the minute internal organization of the plant body.

In the Angiosperms the conduction of food and water through the plant is accomplished by a vascular system comprising longitudinal cellular series known as *vessels* and *sieve tubes*. Since the individual cells which compose these structures are particularly adapted for the conduction of water and dissolved food materials, they possess comparatively large cell cavities and commonly are equipped with thin walls modified by means of openings known as *pits* and *sieve fields* to permit the ready passage of liquid. Accompanying the conducting cells are others providing strength and rigidity to the plant body. These mechanical cells are usually long and slender with comparatively thick, seldom pitted walls and a small cell cavity or *lumen*, a cell type recognized as a *fiber*.

In the disposition of vascular tissue throughout the stem Monocotyledons and Dicotyledons are dissimilar. The former is characterized by a random distribution of vascular tissue in the form of bundles of conducting cells and fibers throughout the entire stem as shown diagrammatically in Figure 1a. Frequently the mechanical fibrous tissue is confined to a *bundle sheath* that flanks or surrounds the bundle. The Dicotyledons, on the other hand, possess vascular bundles which are

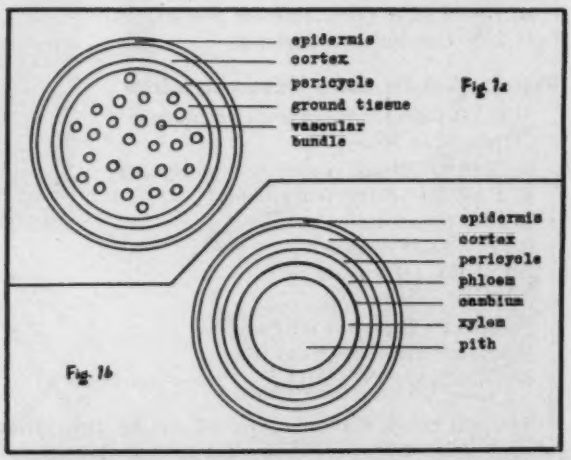

Fig. 1—Arrangement of stem tissues; (a) stem of Monocotyledon, (b) stem of Dicotyledon.

arranged in a ring or, in many cases, the vascular tissue forms a continuous ring without distinct bundles (Figure 1b). On the inner face of this ring of conducting tissue in the Dicotyledons is found typically *xylem*, consisting of vessels, xylem fibers, and *parenchyma;* the latter cells are adapted for the function of food storage. Outside the xylem is a very narrow layer of regenerative tissue known as the *cambium* and beyond the cambium lies the *phloem* consisting of sieve tubes, phloem fibers, heavy walled stone cells for protective purposes, and thin walled storage and conducting parenchyma.

Outside the vascular tissue lie protective layers known as the *pericycle* and *cortex* and finally the outermost layer of cells, the *epidermis*. The paper-making fibers derived from the Monocotyledons may originate in the vascular bundles of the steam or leaf and are designated as *vascular bundle fibers*. Fibers obtained

from the Dicotyledons may arise from the vascular bundle of the stem, phloem, pericycle, or cortex and are commonly known as *bast fibers*. This term came into use in early days as *bass* or bast to designate the fibrous tissue obtained from the outerpart of plant stems due to the fact that the phloem of basswood yielded such material.

A further source of commercial fibers is exemplified by that of cotton. Fibers of this type are *seed-hairs* which are attached at one end to the seed of the plant. This type differs from structural fibers in that it occurs as an isolated unit in nature, whereas the bast or vascular bundle fibers are obtained only by disintegration of the plant tissue in which they were formed.

The following botanical classification of the plants producing commonly used vegetable fibers serves also as a list of the species to be considered in this discussion.

Seed-hairs

COTTON (*Gossypium hirsutum*)

Bast fibers—Dicotyledons

FLAX (*Linum usitatissimum*)
RAMIE (*Boehmeria tenacissima*)
HEMP (*Cannabis sativa*)
MITSUMATA (*Edgeworthia papyrifera*)
JUTE (*Corchorus capsularis*)

Vascular bundle fibers—Monocotyledons

SUGAR CANE (*Saccharum officinarum*)
CORN (*Zea Mays*)
BAMBOO (*Dendrocalamus arundinacea*)
ESPARTO (*Stipa tenacissima*)
RICE (*Oryza sativa*)
RYE (*Secale cereale*)
BARLEY (*Hordeum sp.*)
OAT (*Avena sativa*)
WHEAT (*Triticum sativum*)
MANILA HEMP (*Musa textilis*)
NEW ZEALAND FLAX (*Phormium tenax*)

The cell types that are involved in the descriptions of pulp samples from these species are limited to a small number, practically each one of which, however, is subject to wide variation in appearance even within a single species. In order to facilitate the use of the descriptions to follow, a brief mention of the general features of each type of cell may prove helpful.

Fibers are one of the cell types included among the general group of sclerenchyma—cells characterized by hard, usually lignified walls. These cells die upon reaching mature size so that the cell lumen is almost always free of protoplasm, the living substance from which the cell wall was derived. Fibers are long and relatively narrow, the ratio of length to diameter with few exceptions being greater than 100. Usually the ends of the cell are pointed. The cell walls are typically heavy and while pits may occur in them, they are always extremely small and in the case of all but wood fibers, the pits are simple round or split-like openings in the fiber wall.

Vessels are non-living conducting tubes in the xylem which consist of a series of cells known as *vessel segments* lying end to end. These cells are often broad in comparison with fibers, and their ends are blunt rather than pointed. The end wall is perforated with one or more large openings permitting direct communication between the individual cells. Vessel walls are typically thin and characterized by the presence of numerous variously shaped pits. Of less frequent occurrence are *annular* vessel segments composed of a series of rings and *spiral* vessel segments which consist of a spirally wound cell wall.

Parenchyma is found in many tissues of the plant body. Parenchymatous cells possess the characteristic of remaining alive for a long period of time after reaching maturity, necessitating the retention of active protoplasm within the cell cavity. In general parenchyma cells are about as broad as they are long, their complete end walls are right-angled or oblique, and the cell walls are thin. Since these cells find their chief function in the storage of plant products, they are not profusely pitted as are most vessel segments. The sparse pits which do appear are simple rounded openings.

Epidermal cells constitute the epidermis, the living tissue which encloses the body of plants. These cells are usually thin, and they possess rather equal diameters as seen in surface view. The margins of epidermal cells are commonly toothed as the interlocking of the projecting portions of the cell wall with those of adjacent cells contributes to the bond that preserves the integrity of this exposed outermost layer of the plant tissue. Interspersed among the epidermal cells of stems and leaves are openings which provide for the interchange of gases between plant and surrounding atmosphere. These are the *stomata*. Certain epidermal cells are modified in shape and function to form *trichomes*. Such cells vary in appearance from very short spur-like projection to long tubular hairs, and the fact that their presence or absence may determine the identity of a pulp or paper sample demonstrates the importance of accurate observation.

Characteristics of Individual Species

Cotton *Gossypium hirsutum*

These fibers are, strictly speaking, hairs which have been removed from the capsule of the cotton plant where they were attached to the seed. Because of this attachment the cotton fiber is not completely enclosed but is instead torn at its basal end and rounded at its tip. The fiber is a flat, ribbon-like cell twisted to a greater or lesser degree. The cell wall varies in thickness and it appears as though a greater cell wall thickness is accompanied by a reduction in the spiral twisting. Longitudinal or spiral striations in the cell wall may be observed.

The fiber length varies from 10-40 mm., averaging

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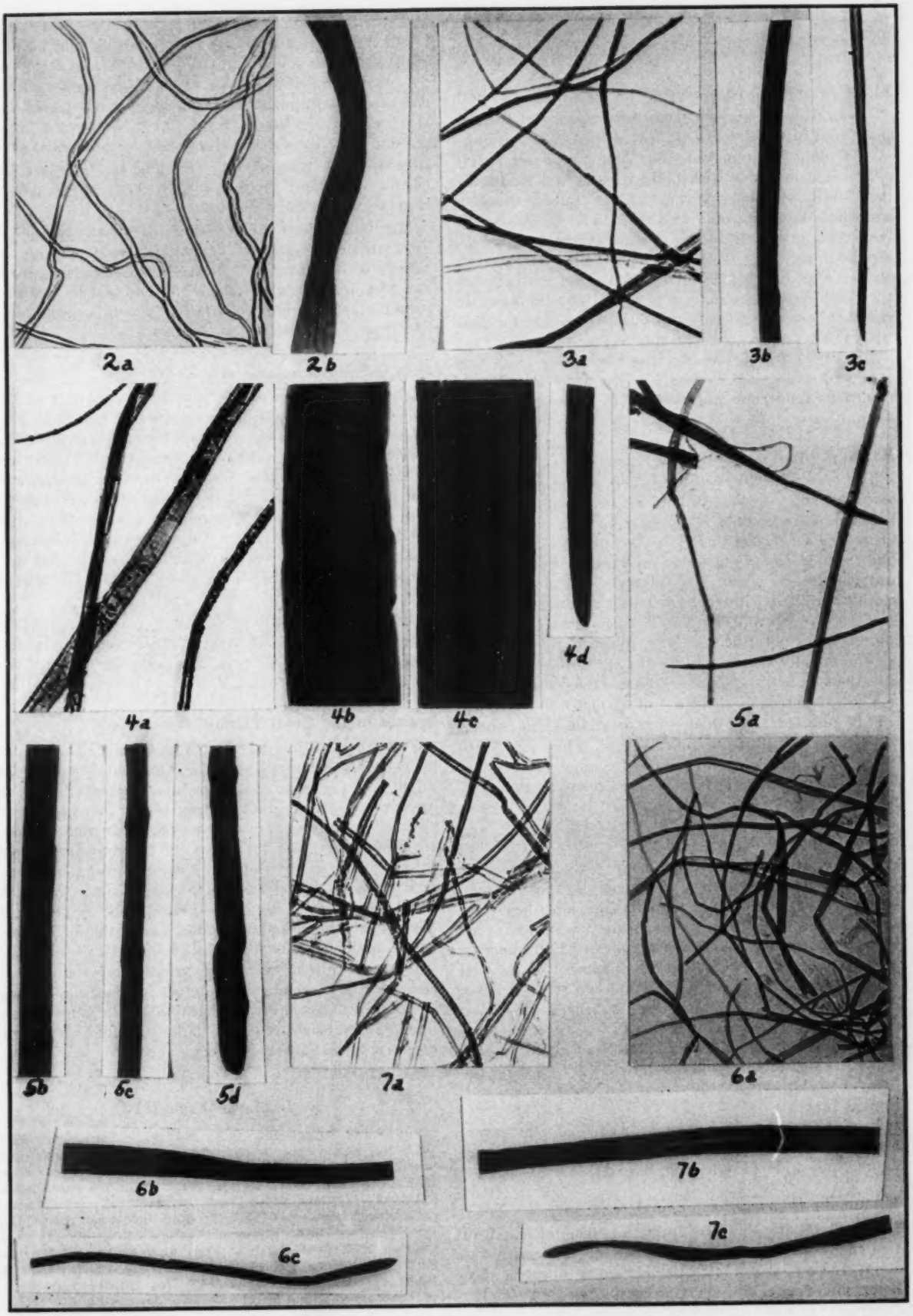
Fig. 2—(a) Cotton 105X. (b) Cotton fiber 380X. Fig. 3—(a) Flax 105X; (b) Flax fiber 380X; (c) Flax fiber end 380X. Fig. 4—(a) Ramie 105X; (b) Ramie fiber 380X; (c) Ramie fiber 380X; (d) Ramie fiber end 380X. Fig. 5—(a) Hemp 105X; (b) Hemp fiber 380X; (c) Hemp fiber 380X; (d) Hemp fiber end 380X. Fig. 6—(a) Mitsumata 105X; (b) Mitsumata fiber 380X; (c) Mitsumata fiber end 380X. Fig. 7—(a) Jute 105X; (b) Jute fiber 380X; (c) Jute fiber end 380X.


2a
2b
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3b
3c
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5c
5d
7a
6a
6b
7b
6c
7c

18.2 mm., and the width across the broad face of the fiber varies from 11.9-37.5 microns, averaging 20.2 microns (Figures 2a, b).

Flax *Linum usitatissimum*

Linen fiber is obtained from the pericycle of the flax plant and in the decorticating process all other tissues of the plant are removed. The long fibers are nearly cylindrical in shape with pointed ends and uniformly thick walls enclosing a very narrow lumen which is sometimes apparent only as a dark line. Characteristic transverse cracks or failures are to be observed in the cell wall and less frequently node-like swellings also occur. Flax tow is more often used in paper manufacture and may be distinguished from linen by the additional presence of fiber cells with broad canals, together with small vessels and epidermal cells.

The fibers are variable in length, ranging from 4-66 mm. and averaging 25 mm. In diameter they range from 6.8-37 microns and average 16 microns (Figures 3a, b, c).

Ramie *Boehmeria tenacissima*

The pericyclic fibers of this plant are practically the only cell type encountered in the ramie of commerce. The fibers are notable for their great size. Individual fibers are characteristically uneven in diameter, varying from sections which are narrow with heavy cell walls to others which are flattened and considerably more broadened without, however, a comparable thickening of the cell wall. The ramie fiber tapers toward the end to a comparatively narrow rounded tip. The cell wall is usually marked by faint longitudinal or spiral striations or by prominent irregular transverse fissures.

The extraordinary length and diameter of these fibers is sufficient for their identification from among those employed in paper manufacture. They vary from 60-250 mm. in length with a mean value of 120 mm. The diameter range is from 10.2-80 microns, the average, 50 microns (Figures 4a, b, c, d).

Hemp *Cannabis sativa*

The pericyclic fibers of the hemp plant are used by the paper manufacturer in the form of rope, cordage, or rags from which other plant tissues have been separated. The hemp fiber is moderately wide and very long with broadly rounded extremities. The lumen is wide, equal to or exceeding the thickness of the cell wall which is characteristically marked with longitudinal striations and transverse fractures appearing sometimes as cracks and sometimes as compressed areas in the cell wall. The fiber resembles that of flax in size and markings but may be distinguished from it on the basis of the blunt cell ends and by the broader obscurely limited lumen.

In size the hemp fibers vary from 5-55 mm., average 20 mm., long and from 6.8-50 microns, average 22 microns, wide (Figures 5a, b, c, d).

Mitsumata *Edgeworthia papyrifera*

The fibers are obtained from the Oriental shrub of this name and occur in the secondary phloem of the stem. In comparison with the pericyclic fibers of flax, hemp and ramie, this fiber is very short and slender. It also differs in outline, being characterized by a fairly broad central segment about 300 microns long beyond which the fiber is comparatively narrow and tapers to a slender rounded point at each end. The walls are thin and occasionally marked with inconspicuous transverse fractures and enclose a lumen which is more than one-third of the fiber width in diameter. An occasional sieve tube element marked by reticulate openings in the lateral walls and rectangular sparsely pitted parenchyma cells may also be observed.

Mitsumata fibers range in length between 2.4 and 3.6 mm. with an average of 2.9 mm. Diameters near the middle of the fiber vary from 11.9-27.3 microns, average 18.4 microns, and outside of that portion the limiting diameters are 6.8-13.7 microns, with a mean value of 9.0 microns (Figures 6a, b, c).

Jute *Corchorus capsularis*

This plant produces the jute fiber as a part of the phloem so that it, and mitsumata as well, may be considered as representing true bast fibrous materials. The individual cells are comparatively short and cylindrical in shape. The external walls of the fiber are smooth and unmarked except for occasional transverse cracks and are drawn out to extremely narrow fiber tips. While the diameter of the fiber shows little variation, the lumen which is commonly as broad as the cell wall is uniquely constricted at irregular intervals to appear as a mere line.

Jute fibers lie between limits of 1.5 and 5 mm. in length and average 2.0 mm., while in diameter variations from 10.2-25 microns, averaging 20 microns, are encountered (Figures 7a, b, c).

Species of the Grass Family—*Gramineae*

The members of the grass family, including sugar cane, corn, bamboo, the cereal straws, and esparto grass might be expected to contain cellular elements of similar appearance. Since in all of these plants the entire stem (as well as the leaves in the case of straws and grasses) is utilized, there is a variety of cell types present in the pulp which readily distinguishes this group of materials from all others used in paper making. The cells which are of value in this respect include rather short fibers from the vascular bundle; barrel-shaped to narrow cylindrical cells from the ground tissue; annular, spiral, and pitted vessels of greatly varying dimensions; and epidermal cells either in fragmentary masses of epidermal tissue or as individuals with more or less irregular margins and commonly equipped with pronounced tooth-like projections.

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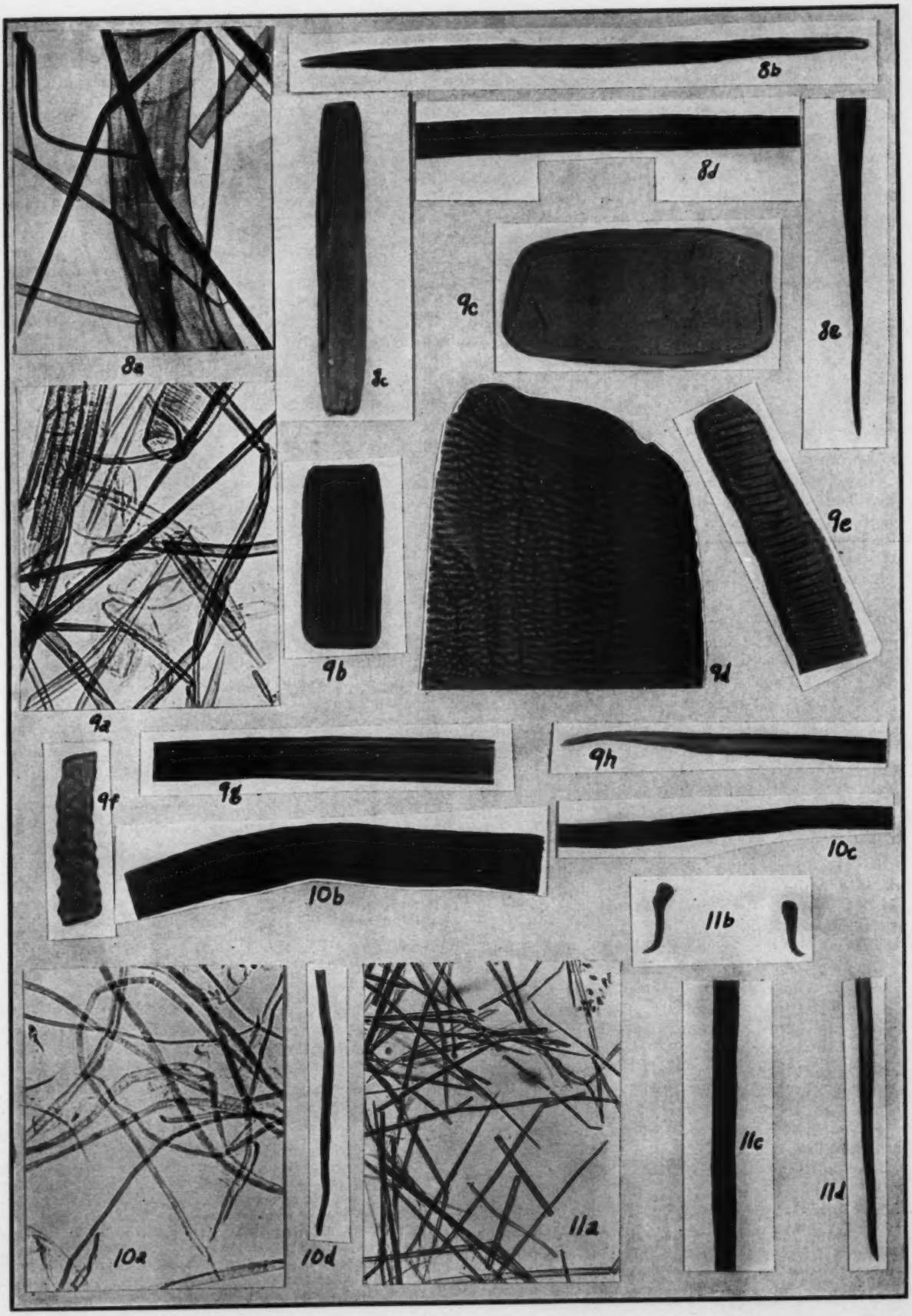
Fig. 8—(a) Sugar cane 105X; (b) Sugar cane short fiber 105X; (c) Sugar cane parenchyma cell 105X; (d) Sugar cane fiber 380X; (e) Sugar cane fiber end 380X. Fig. 9—(a) Corn 105X; (b) Corn vessel segment 75X; (c) Corn parenchyma cell 380X; (d) Corn pitted vessel segment 380X; (e) Corn annular vessel segment 380X; (f) Corn epidermal cell 380X; (g) Corn fiber 380X; (h) Corn fiber end 380X. Fig. 10—(a) Bamboo 105X; (b) Bamboo broad fiber 380X; (c) Bamboo fiber 380X; (d) Bamboo fiber end 380X. Fig. 11—(a) Esparto 105X; (b) Esparto trichomes 380X; (c) Esparto fiber 380X; (d) Esparto fiber end 380X.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11a
11b
11c
11d

Sugar cane *Saccharum officinarum*

The fibers from the vascular bundle have pointed ends and are thin to thick walled with no characteristic markings in the cell wall except for the presence of occasional small pits. Comparatively short fiber-like cells with thin walls and blunt, oblique, or forked ends may also be observed. Parenchymatous cells are thin walled and sparsely to abundantly pitted. Vessels of all types common to the grasses occur but are distinctive due to the great length of the largest ones. Epidermal cells are infrequent and appear as narrow, rectangular, pitted elements with slightly undulating margins. The stomata including the two accompanying guard cells are oval in shape and have entire margins.

Fiber length, 0.8-2.8 mm., averaging 1.7 mm.; diameter, 10.2-34.1 microns, averaging 20.0 microns. Parenchyma cells range up to 850 microns long and 140 microns wide, and vessel segments up to 1350 microns long and 150 microns wide may be observed (Figures 8a, b, c, d, e).

Corn *Zea Mays*

The preceding general description also applies to the cells derived from corn stalk. The differences between these two materials are limited to variations in size of similar elements, namely, to shorter and more slender fibers, shorter parenchyma cells, and shorter vessel segments.

The typical fibers vary from 0.5-2.9 mm., average 1.5 mm. in length and 13.7-23.9 microns, average 18.1 microns, in width. Shorter thin walled fiber cells with sloping pits in their lateral walls are also present; these average 0.44 mm. long and 16.4 microns in diameter. Parenchyma cells range up to 325 microns long and 150 microns wide, and vessel segments are shorter than those of sugar cane, reaching a maximum size of 600 microns long by 150 microns wide (Figures 9a, b, c, d, e, f, g, h).

Bamboo *Dendrocalamus arundinacea*

Again the general description as given for sugar cane may be applied. Aside from the fact that spiral and transverse checks as well as irregular compressed areas are of frequent occurrence in the fiber walls, this species may be distinguished by differences in cell dimensions.

Typical fibers range from 1.45-4.35 mm., averaging 2.7 mm., in length and from 6.8-27.3 microns, average 14.0 microns, in diameter. These are augmented by very wide, pitted, thin walled fibers varying from 2.8-3.2 mm. in length and from 20.5-41.0 microns in width. Parenchyma cells are smaller than in the preceding species as the maximum length is about 250 microns and the maximum diameter 65 microns. Vessel segments are also smaller than in sugar cane or corn, reaching a maximum width of about 100 microns (Figures 10a, b, c, d).

Esparto *Stipa tenacissima*

This grass species is characterized by short-pointed fibers with thick to thin walls; numerous small epidermal cells with sharp-toothed margins interspersed with abundant erect pear-shaped trichomes which are hooked at the apex; and small parenchyma cells and vessel segments. The guard cells surrounding the stoma are smooth walled as in sugar cane.

The dimensions of the fibers are as follows: length, 0.51-1.6 mm., average 1.1 mm.; diameter, 6.8-13.6 microns, average 9.2 microns. Parenchyma cells range up to 350 microns long and 20.5 microns wide and the largest vessels attain the same width. Epidermal cells are from 6.8-13.6 microns wide in surface view and display abundant round pits. The trichomes are from 30-50 microns long and 17 microns wide (Figures 11a, b, c, d).

Rice *Oryza sativa*

The cell types by means of which this straw is identified are identical with those of esparto, differing from that species, however, in appearance and size of these elements. Rice fibers are somewhat more slender than those of esparto but their length is greater. The heavily pitted epidermal cells are larger and occurring among them in fragments of epidermal tissue are prominent appressed trichomes and stomata surrounded by conspicuously dentate guard cells.

In length the fibers vary from 0.65-3.48 mm., average 1.45 mm. In diameter the limits of variation are 5.1 and 13.6 microns with a mean value of 8.5 microns. The barrel-shaped parenchyma, which characterize all of these grass species save esparto, together with cylindrical cells of the same type range up to 350 microns long and 82 microns wide. Vessel segments are long and slender, reaching a maximum size of 650 by 40 microns. Trichomes are 38-45 microns in length with short straight tips and their width is 17 microns. The epidermal cells vary from 10.2-20.5 microns wide in surface view (Figures 12a, b, c, d).

Barley *Hordeum sp.*
Oat *Avena sativa*
Rye *Secale cereale*
Wheat *Triticum sativum*

While macerated samples of these four straw species are not identical, their separation is attended by so many difficulties that the writer prefers to consider them as a group. Straw fibers are somewhat longer and broader than those of esparto. The ends are pointed and the fiber lumen may be broad or narrow. Barrel-shaped and cylindrical cells of the ground tissue are abundant as are the comparatively large, more or less toothed, sparsely pitted epidermal cells. The stomata together with their smooth walled guard cells are oval in shape. Rather inconspicuous erect trichomes are present but are far less frequent in occurrence than those observed in esparto and rice. Vessel segments

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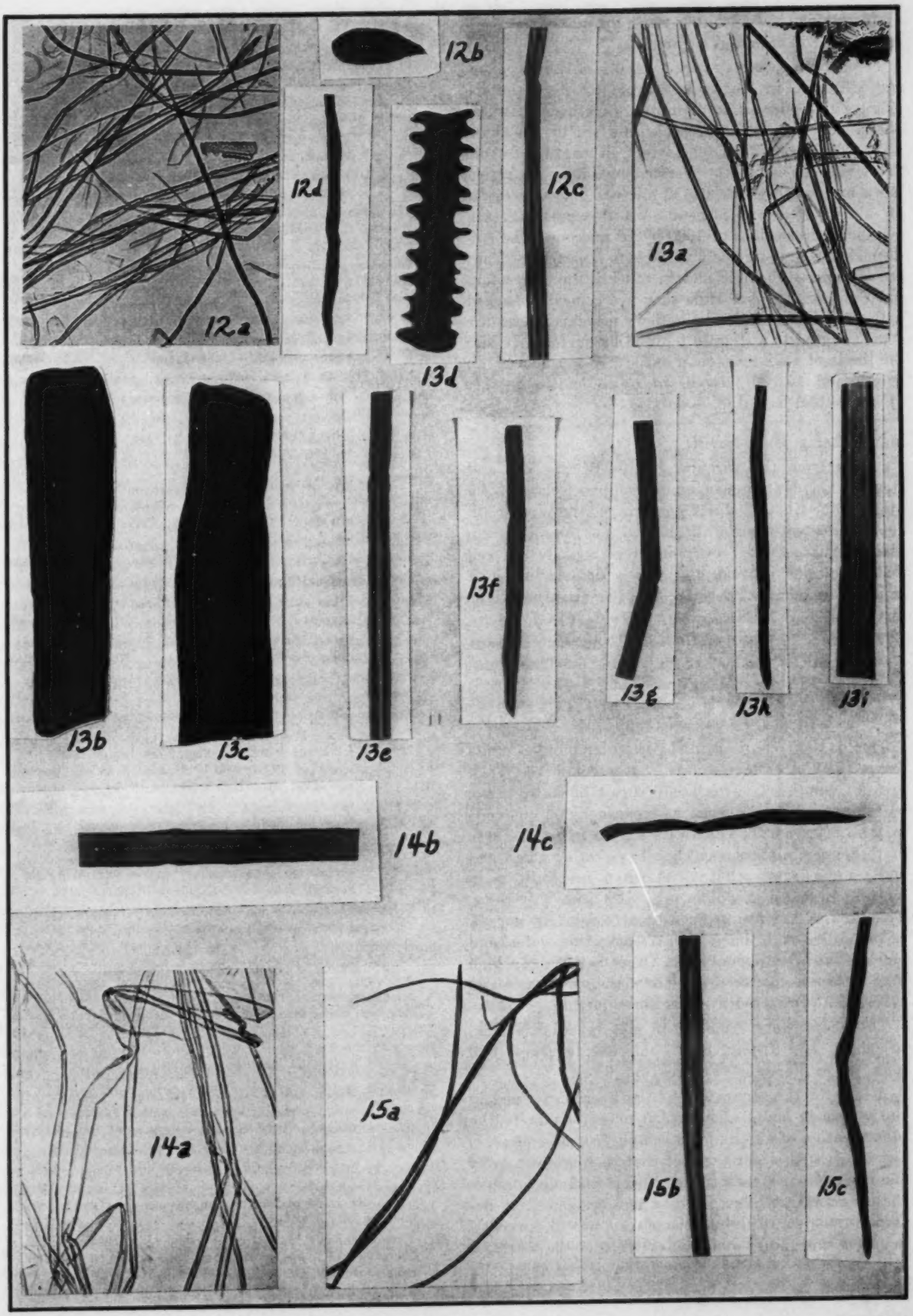
Fig. 12—(a) Rice 105X; (b) Rice trichome 380X; (c) Rice fiber 380X; (d) Rice fiber end 380X. Fig. 13—(a) Rye 105X; (b) Rye parenchyma cell 380X; (c) Rye pitted vessel segment 380X; (d) Rye epidermal cell 380X; (e) Rye fiber 380X; (f) Rye fiber end 380X; (g) Wheat fiber 380X; (h) Barley fiber end 380X; (i) Oat fiber 380X. Fig. 14—(a) Manila hemp 105X; (b) Manila hemp fiber 380X; (c) Manila hemp fiber end 380X. Fig. 15—(a) New Zealand flax 105X; (b) New Zealand flax fiber 380X; (c) New Zealand flax fiber end 380X.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15b
15c

are variable in size but never reach the maximum diameters found in corn and sugar cane.

Typical straw fibers range from 0.68-3.12 mm., average 1.48 mm. in length, and from 6.8-23.8 microns, average 13.3 microns, in diameter. Together with these fibers are others which are characterized by very thin walls. These vary from 0.8-2.9 mm. in length and from 27-34 microns in width. Parenchymatous cells reaching a maximum length of 450 microns and a diameter of 130 microns are present. Vessel segments reach maximum dimensions of 1000 by 60 microns. The epidermal cells are extremely variable in appearance. They are sometimes rhombic and in other instances rectangular in outline, and while they are typically marked with prominent teeth along their margins, these are often reduced to a slightly undulating surface. In size the limits of variations observed are 36-445 microns in length and 10.2-41 microns in width on the surface (Figures 13a, b, c, d, e, f, g, h, i).

Manila hemp *Musa textilis*

Fibers from the vascular bundle of the leaf and stem of this plant appear in pulp samples isolated from other plant tissues. The fibers are relatively short in comparison with pericyclic fibers. The Manila hemp fiber is characterized by pointed ends and thin cell walls enclosing a broad and clearly defined lumen of uniform diameter. There are no distinctive markings in the cell walls.

Variations in fiber length from 2.5-12 mm., average 6 mm., occur and diameters range from 6.8-32 microns, averaging 15.7 microns (Figures 14a, b. c).

New Zealand flax *Phormium tenax*

This flax lily contains in the vascular bundles of its leaves the fibers which are utilized in commerce. They are not completely separated from other leaf tissue so that at times epidermal and parenchymatous cells may be observed. The fibers are similar in size to those of the preceding species. They have rather thick cell walls and narrow cell cavities which are uniform in width but distinguishable only with some difficulty. The ends of the fibers taper to a moderately narrow point. A few of the fibers are extremely thin walled and marked with occasional pits. Other cell types which may be seen are vessel segments of the spiral type and others sculptured with scalariform pitting.

The fibers range from 3.9-15 mm., average 9 mm., in length and from 6.8-27.3 microns, average 16.0 microns, in diameter (Figures 15a, b, c).

A key for the separation of the fibers described in this paper is included as a convenient guide to the identification of an unknown sample from one of these species as well as for the fact that it provides a brief summary of the essential features that distinguish these materials. After the key has been used to determine the identity of a fibrous specimen, it is recommended that additional characteristics be checked with the more complete description of the species in question.

KEY TO COMMERCIAL PAPER FIBERS

1. Fibers so long that under the ordinary microscope cover glass complete fibers are rare 2
1. Fibers comparatively short. By moving the glass slide on the microscope stage complete fibers may be commonly observed 5
    2. Fiber flat and usually twisted about its longitudinal axis ..... **Cotton**
    2. Fiber cylindrical and not twisted; transverse fractures in the cell wall prominent 3
3. Diameter of fiber varying considerably throughout its length, the broadest portions up to 80 microns in width ..... **Ramie**
3. Diameter of fiber quite uniform, the broadest fibers 50 microns wide 4
    4. Thick fiber walls enclose a clearly defined narrow lumen; fiber ends pointed ..... **Flax**
    4. Lumen rather obscure, often broader than the fiber wall; fibers blunt tipped ..... **Hemp**
5. Cells other than fibers occurring only occasionally 6
5. Parenchyma cells and vessel segments of frequent occurrence 9
    6. Fibers characterized by a rather broad central segment about twice the average diameter of the fiber in width ..... **Mitsumata**
    6. Fibers comparatively uniform in diameter throughout their length except near their narrow ends 7
7. Lumen of the fiber constricted at irregular intervals to appear as a line ..... **Jute**
7. Fiber lumen uniform in width 8
    8. Fiber walls thin; lumen broad and distinct ..... **Manila hemp**
    8. Fibers mostly thick walled; lumen narrow and indistinct ..... **New Zealand flax**
9. Epidermal cells abundant, margins rather distinctly dentate 10
9. Epidermal cells sparse, margins undulating 12
    10. Barrel-shaped parenchyma cells absent, none more than 20.5 microns wide; epidermal cells less than 14 microns wide among which appear abundant erect trichomes with hooked apices ..... **Esparto**
    10. Barrel-shaped parenchyma cells present, up to 130 microns wide; epidermal cells usually more than 14 microns wide; trichomes appressed to surface or comparatively sparse and erect, not hooked 11
11. Trichomes conspicuous as flattened spur-like projections among epidermal cells; epidermal cells profusely pitted; stomata accompanied by dentate guard cells; fibers 5.1-13.6 microns in diameter ..... **Rice**
11. Trichomes inconspicuous, erect; epidermal cells seldom pitted; stomata accompanied by guard cells with entire margins; fibers 6.8-23.8 microns in diameter ..... **Barley**
    ..... **Oat**
    ..... **Wheat**
    ..... **Rye**
    12. Fibers up to 4.3 mm. in length, average 2.7 mm.; extremely wide, thin walled, ribbon-shaped fibers up to 40 microns wide present ..... **Bamboo**
    12. Fibers up to 2.9 mm. in length; broadest fibers not ribbon-shaped, 34 microns in width 13
13. Vessel segments very long, up to 1350 microns; fibers up to 34 microns wide; parenchyma cells up to 850 microns long ..... **Sugar cane**
13. Vessel segments comparatively short, maximum length 600 microns; fibers up to 24 microns wide; parenchyma cells up to 325 microns long ..... **Corn**

(Concluded on Page 794.)

STARCH IN PAPER

Microscopical Observations of Beater and Surface Applied Starches

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THE first sizing material known to have been used in paper was starch. The early Chinese paper makers used it. It was used by the Arabians and probably by the earliest European manufacturers. Its use was largely discontinued in Europe about the 14th century when glue began to be used. With this and the introduction of rosin in the early 19th century starch became relatively unimportant. However, in recent years with more starches available and particularly with the application of modified starch products capable of producing more specific results, the use of starch has greatly increased. In fact, starch has turned the tables on its old rival glue, and is now frequently used in its place, especially in surface sizing. Furthermore, starch gives properties to paper which neither glue nor rosin afford. While glue and rosin will probably always have a place in paper manufacture it appears likely that starch will be increasingly important for many years to come, and all the more so as increasing knowledge becomes available of the most effective ways to use the various products now on the market.

Methods Now Used in Starch Examination in Paper

The usual methods for identification and analysis of starch in paper[1] describe only its presence, general character and amount. They do not tell the form, structure, distribution, relation to fiber or other materials, nor do they afford much direct information as to the specific effects of the various starch products in paper. These can be satisfactorily obtained by microscopical examinations. In studies of the application and relation of starch products to paper properties and use requirements these factors may be of more importance than is the unsupported knowledge of the amount of starch present.

It is well-known and accepted that raw starch, regardless of its origin, when moistened with a water solution of iodine in potassium iodide, reacts to give a blue color. Furthermore, when starches are modified by various treatments other colors than blue result from the addition of iodine.

In general, raw starches are insoluble in cold water and react blue. With increasing modification most of the starch products become more soluble and the color reaction becomes more reddish until finally brown is reached. Eynon and Lane[2] list the following color reactions for starch and some of its products when 0.1 gram of the material in water is heated until the substance is dissolved, diluted to 100 cc. of water, and treated with one drop of N/10 iodine.

Falling Drop	*After Shaking*	*Per Cent Water Soluble*
Blue	Blue	0.0
Blue	Pale blue	6.1
Blue violet	Pale blue	15.2
Violet	Violet	39.2
Violet red	Pale violet	49.5
Reddish brown	Colorless	62.5

It is not so well-known that starches giving a blue reaction in the raw condition may, after going through the paper making process, show blue in part of the paper and distinctly reddish in another part when examined with the microscope under brilliant illumination.

Different Substances in the Starch Grain

T. Clinton Taylor[3] in *A Comprehensive Survey of Starch Chemistry* describes the different substances that occur in the starch granule, particularly as they are made apparent by treatment. "Treating starch with water and heat brings about swelling and ultimate rupture and makes available the amorphous substance which is within the granules. While partial swelling is accomplished with relative ease it is by no means uniform, some granules changing greatly and some only slightly. The break or rupture releases more or less of the starch material, part of which goes into solution and part of which does not. The insoluble portion has been designated as *d* and the soluble portion *B* amylose." The insoluble part is also called amylopectin and the soluble amylose. The amylopectin is apparently the part involved in acid modification.

These present studies have produced no positive evidence that the soluble, blue-coloring portion of the starch granule does actually penetrate into the finer structure of the cellulose fiber. What can be definitely observed is that a very thin layer of blue color shows on the extreme surfaces of the fibers. That the blue coloration does not clearly show in the interiors of the cell walls is not necessarily proof that no starch is there. It might be that the iodine solution does not penetrate or that the starch is held in a form that does not react with iodine.

Taylor further states there are at least two substances in the common cereal starches. One is a slimy, insoluble material, slightly heavier than water, while the other is a rather soluble material which gives with iodine test solution the characteristic blue coloration. Accepting this as established it seems reasonable to believe that the slimy portion is the part that affords

the adhesive qualities which may serve to bind the paper fibers more securely together. While it is too much to assume definitely that the reddish-reacting part is that which has the adhesive properties exclusively, it is logical to believe that the highly soluble blue-reacting portion which travels so distinctly to the surfaces is not the most adhesive. Regardless of which part is adhesive it appears obvious that varying methods of preparation and handling will have vastly different effects on the properties of the finished papers depending on the degree of solution and distribution of the starch.

Sjostrom[4] says, "Starch users in general are familiar with the fact that there is a great difference between individual starches in the character of the paste made from each starch and its modifications and that these individual characteristics determine whether a starch is suitable for specific purposes." Concerning this he further states, "In regard to such differences microscopic investigation has so far given very little information." He then describes various starches and their modifications, but not as they are used and occur in paper.

Our experience, unlike that of Sjostrom in his studies of starch products alone, is that microscopical examinations of such products in papers has, as far as they have been applied, given results of distinct commercial value. To be of greatest use such investigations require detailed correlations between many factors. These include not only the starch product and the circumstances of its application, but also data on the operation of the paper machine, rosin size and other added materials, microscopical structure of the finished paper and the test properties and actual use requirements of the paper. Complete data are not easy to secure but even a modicum of information greatly assists in the correct choice of the starch products and their use in the production of papers to meet specified uses.

General Descriptions of Illustrations

There appear to be no published descriptions of the actual appearance and distribution of starch or of starch products in paper. It is the purpose of this article to give some such descriptions. To this is added a few variations due to different conditions. Possibilities of extending investigations are also indicated.

Figures 1 to 4 are color photomicrographs taken after staining sections of paper with iodine in potassium iodide. The making of such photomicrographs is not entirely easy or satisfactory. It is not easy to show the fiber and starch detail equally distinctly and, where colors are dense, as in unswollen starch granules, the photographs which are made with transmitted light, naturally reproduce too much like black. This is the case in Figure 1 as may be seen by comparing Figure 6 which is a semi-diagrammatic representation of a similar starch condition. Figure 2 is the surface and Figure 3 the interior of the tag paper shown in Figures 17, 18 and 19. Figure 4 is the surface of a sulphite paper which was surface treated like the sample illustrated in Figure 24. In Figure 4 it is quite evident that no definite, complete, uniform film covers the surface of the sheet although this paper had been heavily surface treated with starch.

Comparing the direct photomicrographs with the semi-diagrams (Figures 5-28) it will be noted that, in the latter, some crowded detail, especially of the fiber structure, may have been omitted for the sake of clearness. It has not been attempted to reproduce exactly the colors obtained by staining; nevertheless the colors are reasonable representations. The colors as seen in the microscope may vary with different strengths of solutions, time and temperature. The photomicrographs were made and are reproduced at 150 diameters. The semi-diagrams were made, some with the help of the camera lucida, at about 450 diameters and are reproduced at half size or about 300 diameters. The density or the thickness of the blue colors as shown are more or less exaggerated, especially in the case of cross sections such as Figure 19. The blue colors are frequently very thin and difficult to see at all. In fact, it is quite probable that in some papers starch is present but in such minute amounts as to make it invisible after staining with iodine, when high magnifications are used. The portion represented by the reddish colors are, on the other hand, frequently dense, even more dense than is satisfactory to attempt to reproduce without making them appear as black.

Appearance of Uncooked Starch in Paper

When raw starch is mixed directly with paper stock which is then made into sheets without heating, or with very little heating, the original starch granules are little altered. They may frequently be identified with the microscope by their specific characteristics. Figure 5 is an example of a raw rice starch in a fine Italian drawing paper. As is typical of rice starch the granules are very fine. They are little swollen since the paper was heated only to low temperatures in drying. They occur simply lying in the space between the fibers. The fibers themselves are not colored blue when treated with iodine solution which indicates none of the starch has gone into solution. Practically no blue reaction shows when iodine is applied to the surface of this paper. Only careful microscopical examination discloses positively the presence of starch. Figure 6 shows the appearance of raw starch in an unbleached sulphite wrapping paper. Pearl cornstarch was used which was not cooked before being added to the beaters. The starch shows only as widely separated granules which are but slightly swollen. Iodine colors the granules blue while the fibers exhibit no color under the microscope. As in the previous paper, surface staining shows little or no indications of starch except by microscopical tests.

Even in the case of some modified starches where the granules are not essentially altered in size and shape little or no further swelling or other distinguishable change takes place when the starch is mixed with fiber and made into paper without heating. This is illustrated in Figure 7 which shows a well-known modified starch in a book paper stock which was made into sheets without heat. Many of the starch granules are of the size and shape of unaltered cornstarch. The paper fibers are uncolored by iodine solution.

Effect of Heat

When water suspensions of starch are heated the granules swell and lose their specific characteristics.

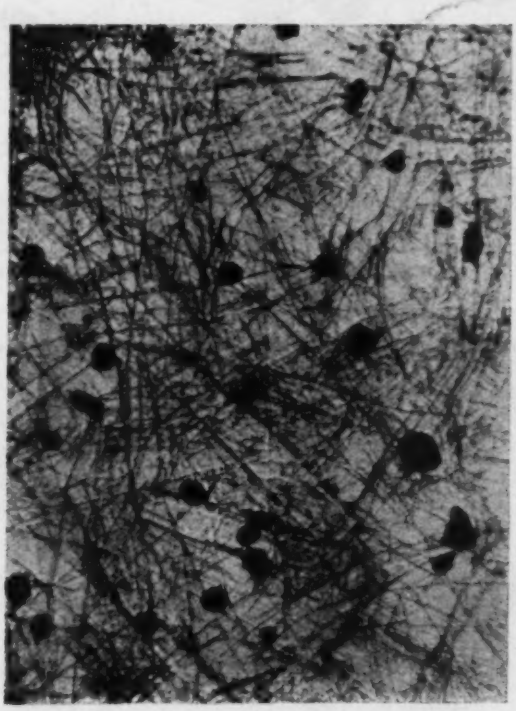

Fig. 1 Thin sulphite paper with uncooked beater starch. x 150

Fig. 2 Top surface of tag paper with beater starch. x 150

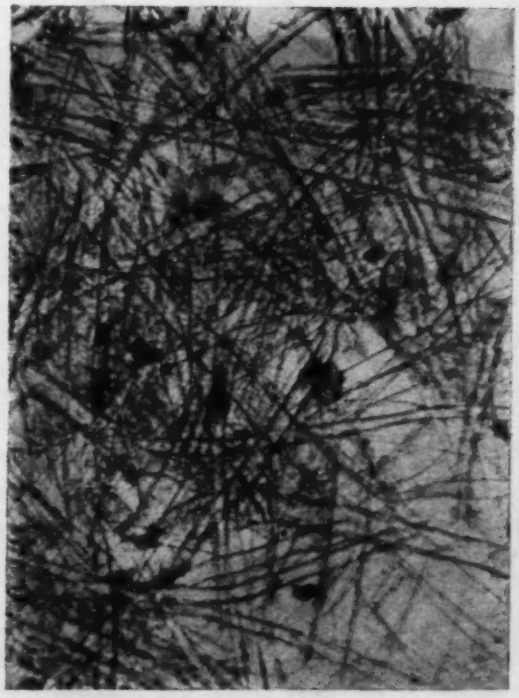

Fig. 3 Interior of tag paper with beater starch. x 150

Fig. 4 Surface of sulphite paper surface treated with modified starch. x 150

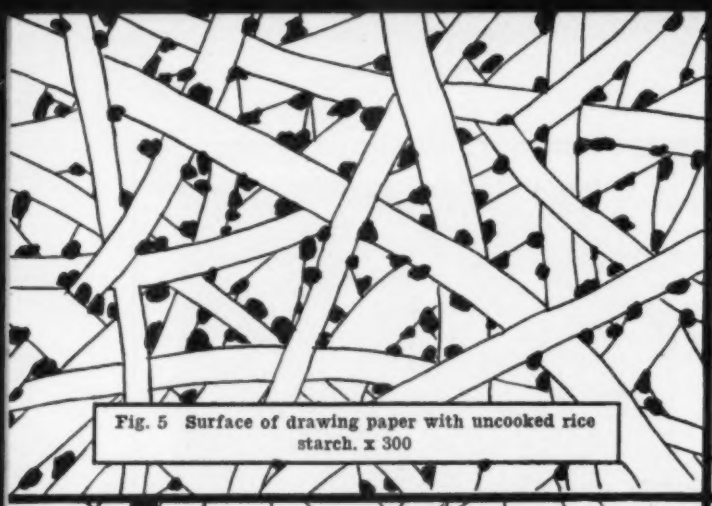

Fig. 5 Surface of drawing paper with uncooked rice starch. x 300

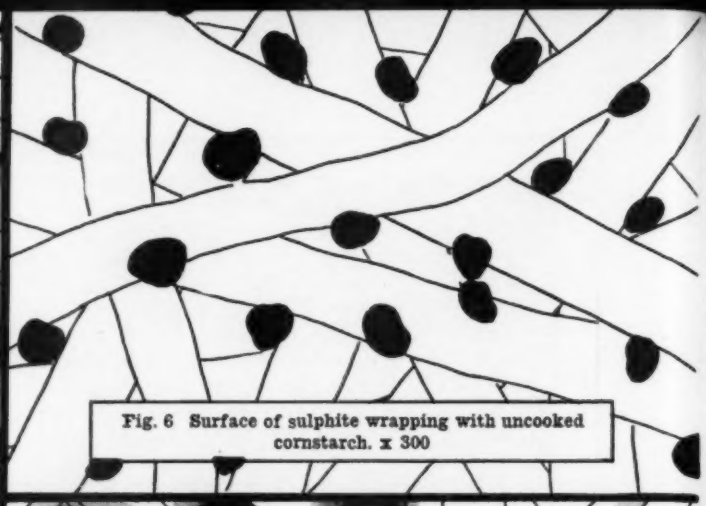

Fig. 6 Surface of sulphite wrapping with uncooked cornstarch. x 300

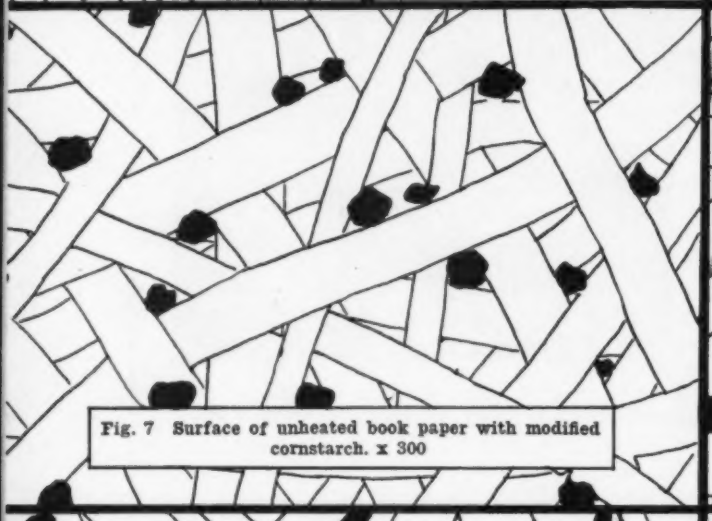

Fig. 7 Surface of unheated book paper with modified cornstarch. x 300

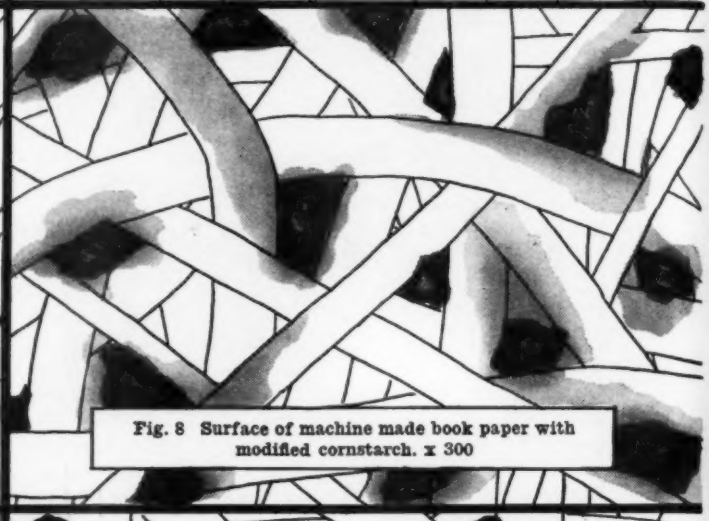

Fig. 8 Surface of machine made book paper with modified cornstarch. x 300

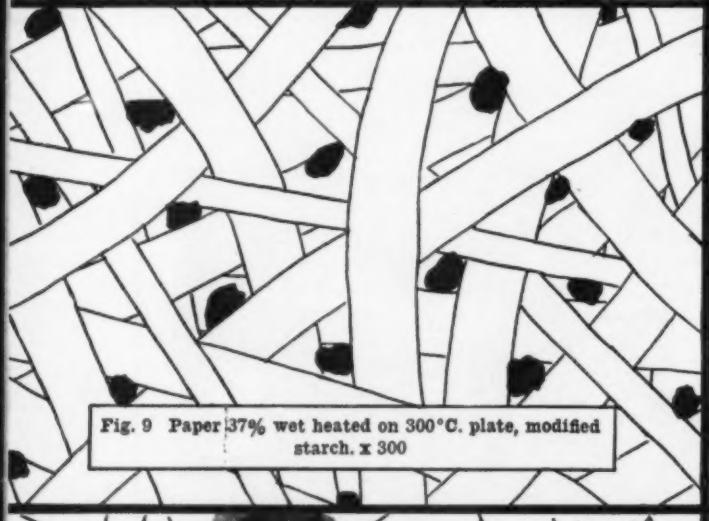

Fig. 9 Paper 37% wet heated on 300°C. plate, modified starch. x 300

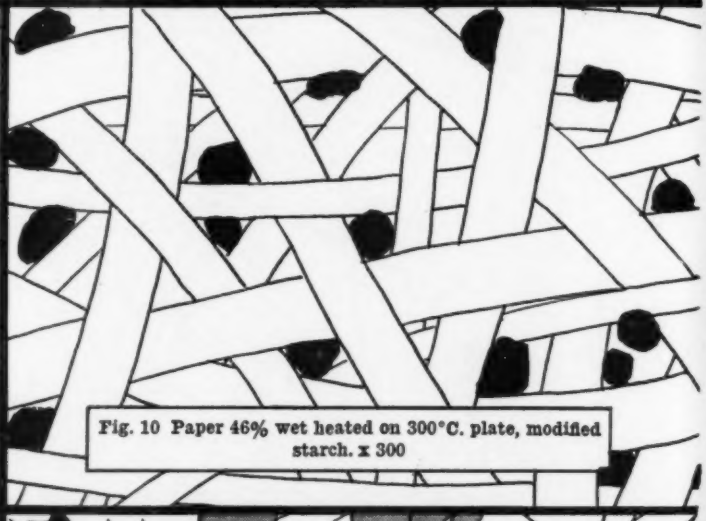

Fig. 10 Paper 46% wet heated on 300°C. plate, modified starch. x 300

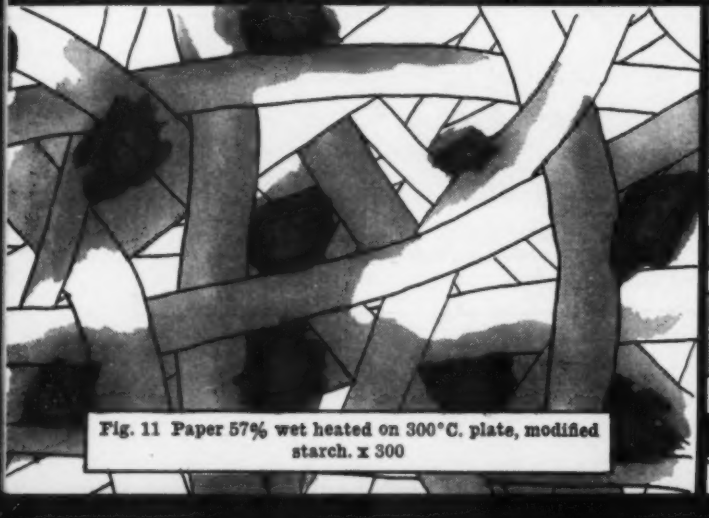

Fig. 11 Paper 57% wet heated on 300°C. plate, modified starch. x 300

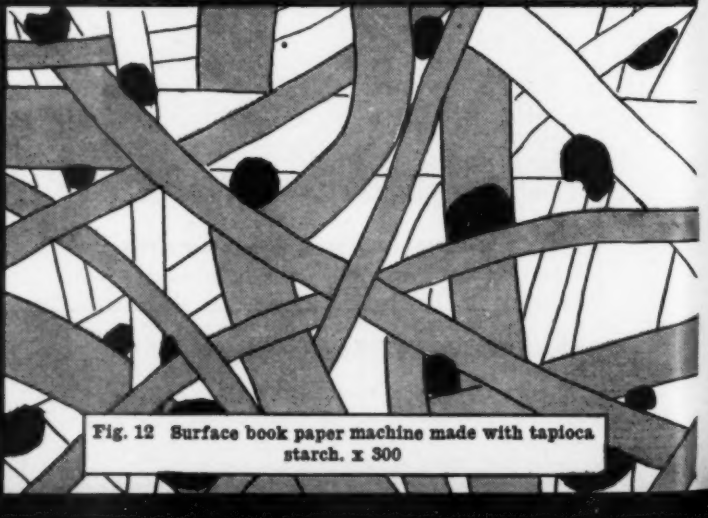

Fig. 12 Surface book paper machine made with tapioca starch. x 300

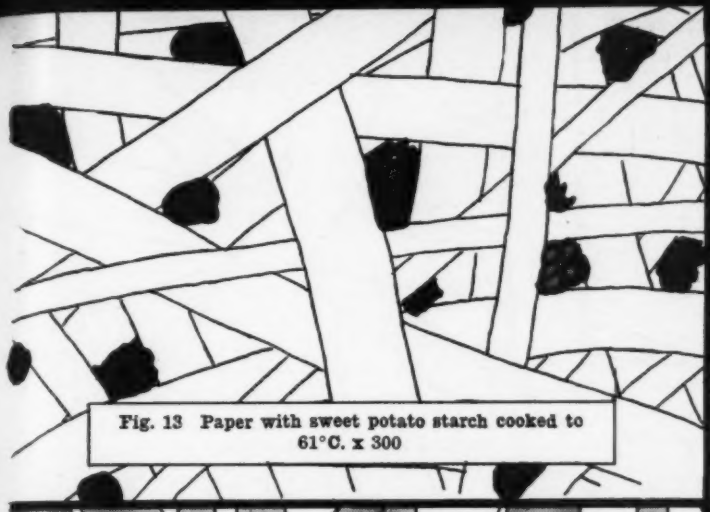

Fig. 13 Paper with sweet potato starch cooked to 61°C. x 300

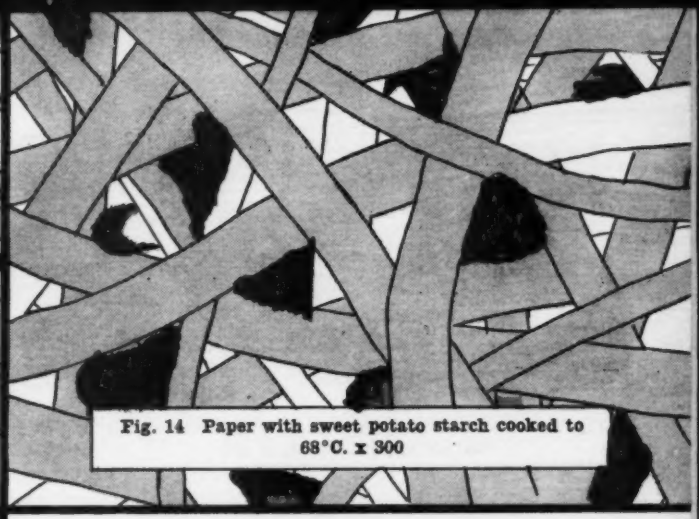

Fig. 14 Paper with sweet potato starch cooked to 68°C. x 300

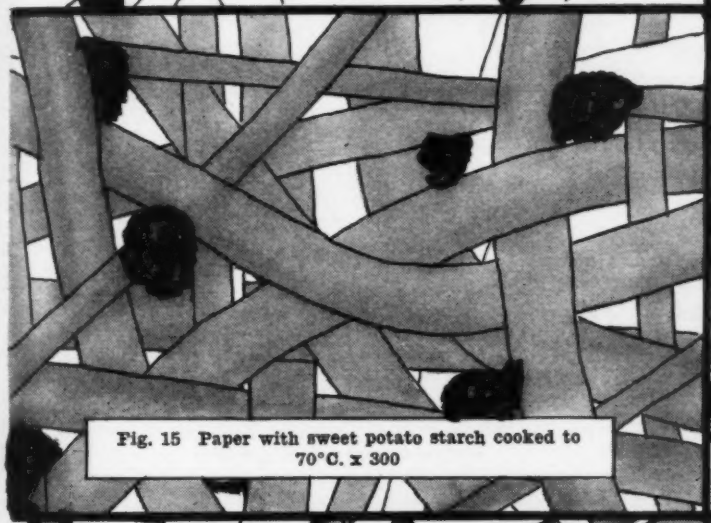

Fig. 15 Paper with sweet potato starch cooked to 70°C. x 300

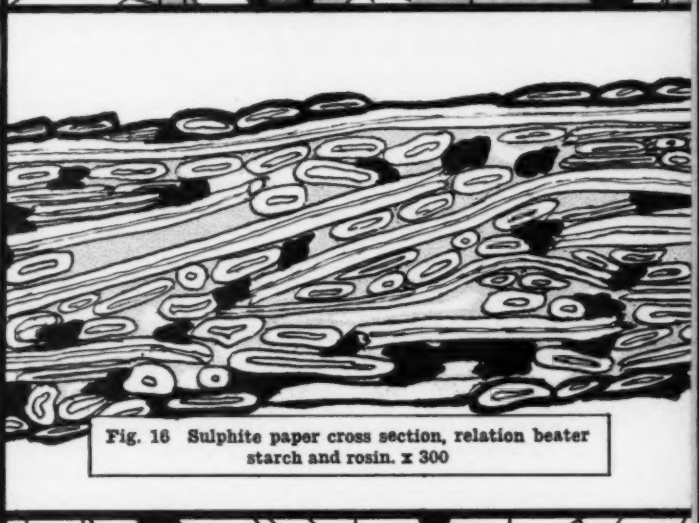

Fig. 16 Sulphite paper cross section, relation beater starch and rosin. x 300

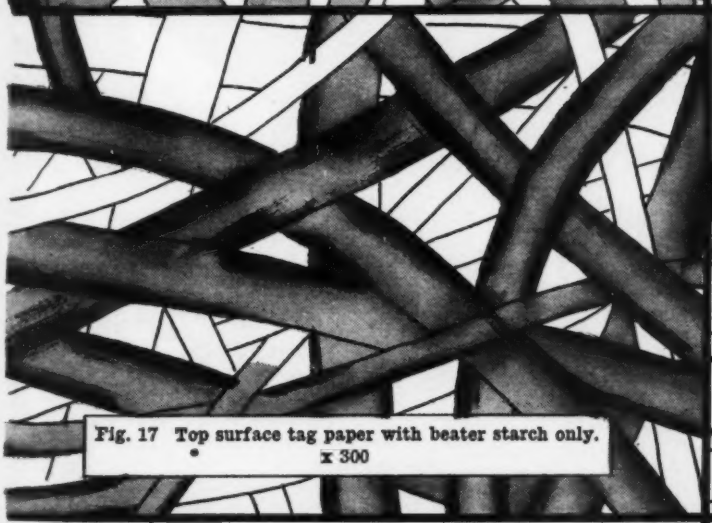

Fig. 17 Top surface tag paper with beater starch only. x 300

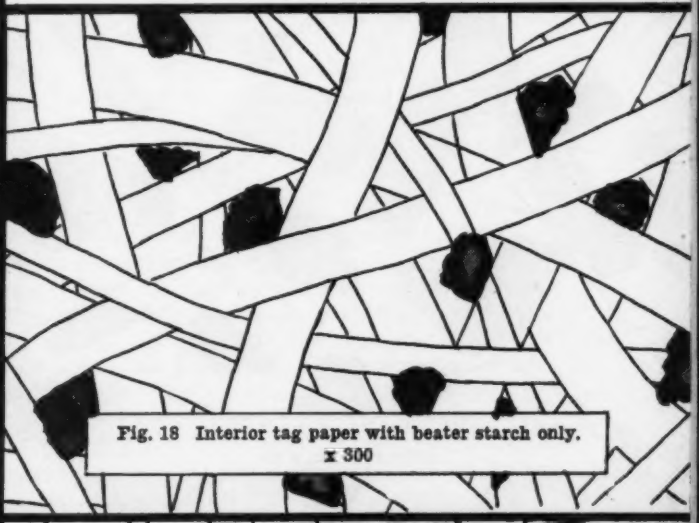

Fig. 18 Interior tag paper with beater starch only. x 300

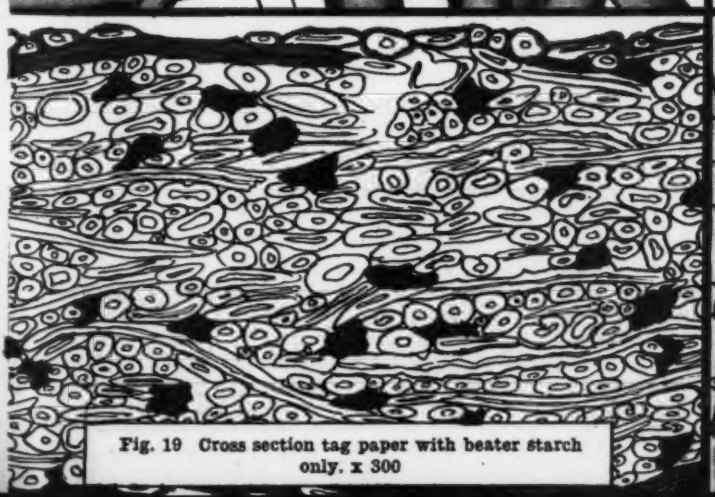

Fig. 19 Cross section tag paper with beater starch only. x 300

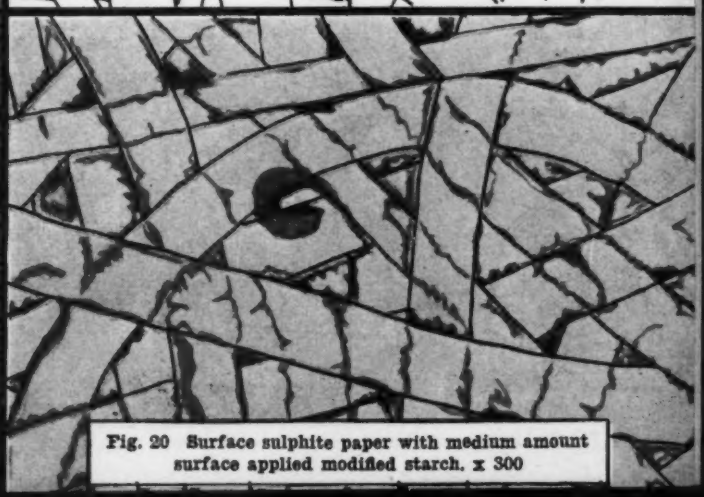

Fig. 20 Surface sulphite paper with medium amount surface applied modified starch. x 300

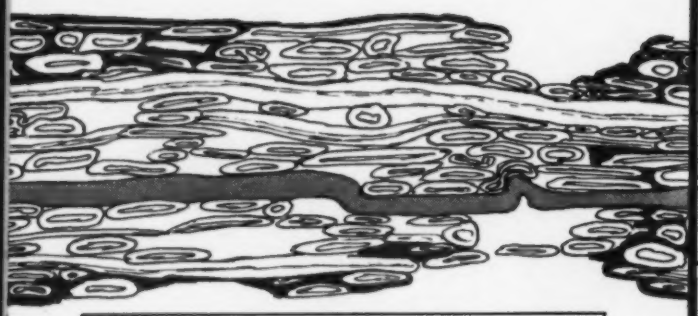

Fig. 21 Cross section sulphite paper with small amount surface applied starch. x 300

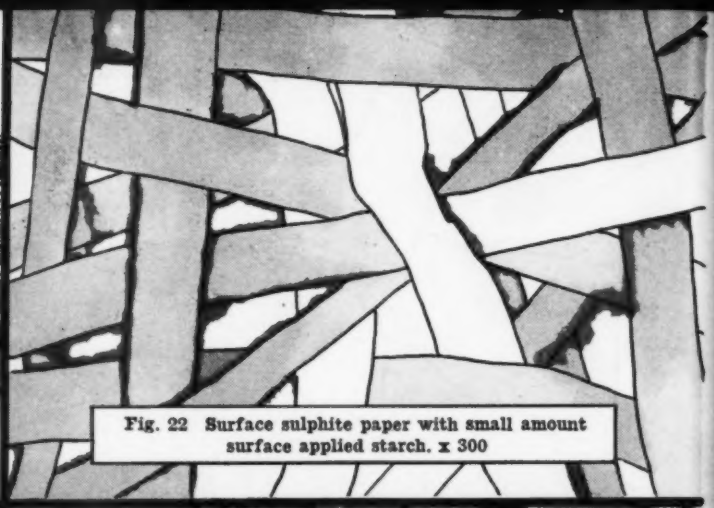

Fig. 22 Surface sulphite paper with small amount surface applied starch. x 300

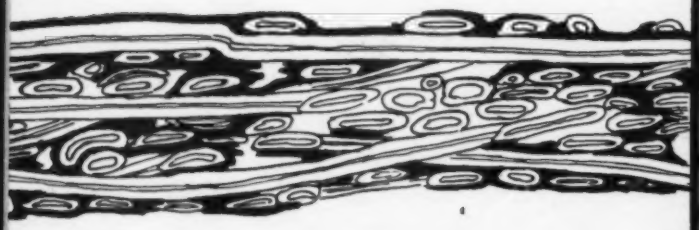

Fig. 23 Cross section sulphite paper with large amount of surface applied modified starch. x 300

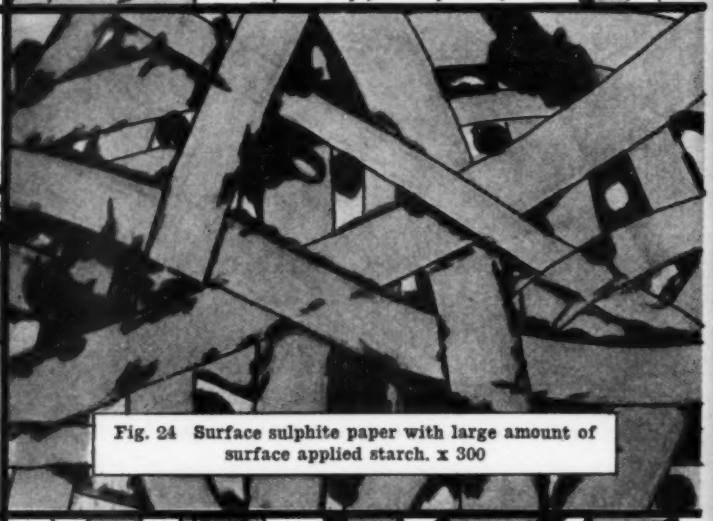

Fig. 24 Surface sulphite paper with large amount of surface applied starch. x 300

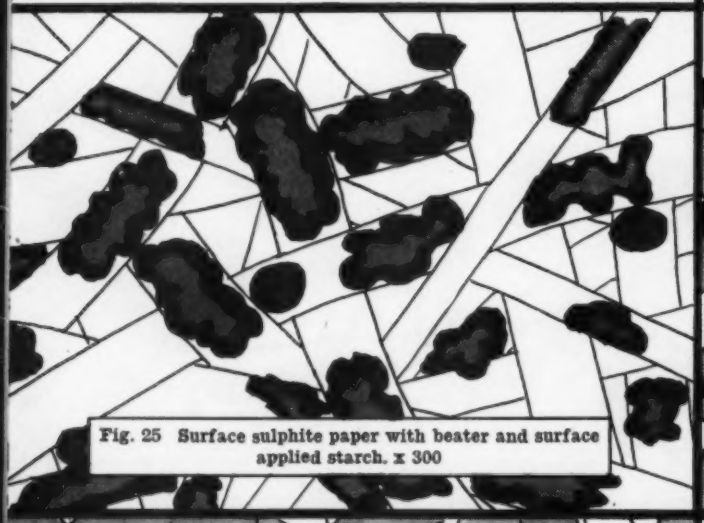

Fig. 25 Surface sulphite paper with beater and surface applied starch. x 300

Fig. 26 Surface sulphite paper with surface applied starch only. x 300

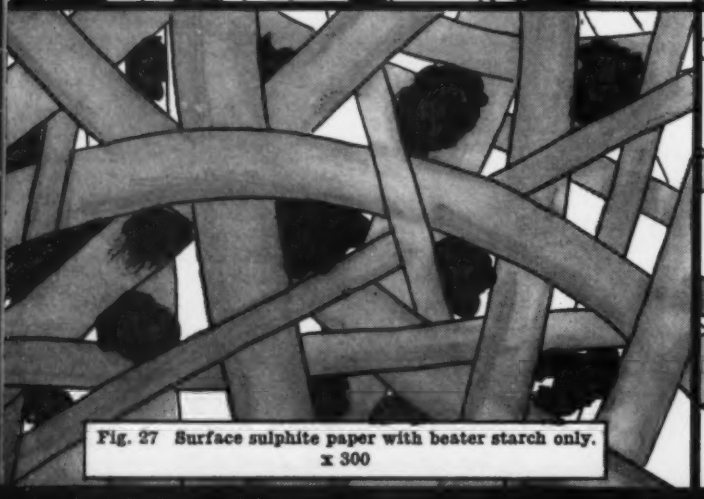

Fig. 27 Surface sulphite paper with beater starch only. x 300

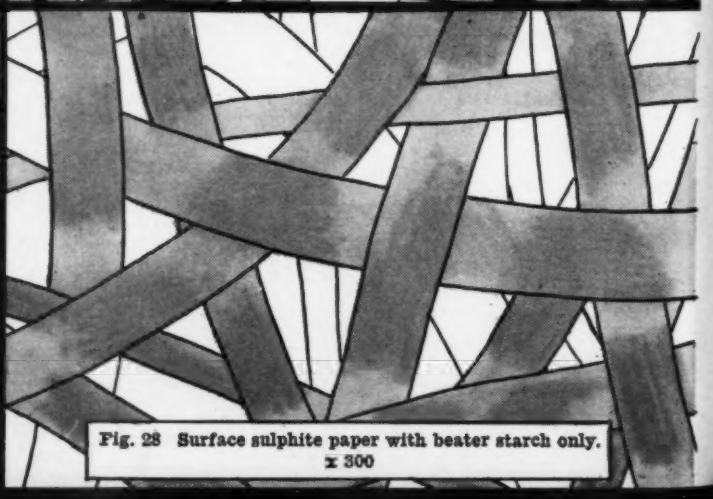

Fig. 28 Surface sulphite paper with beater starch only. x 300

If the heating is carried far enough, especially with agitation, all traces of the original granules are lost. The effect of swelling of the starch grains in paper is illustrated in Figure 8. This is exactly the same paper and the same modified starch as is shown in Figure 7 but in Figure 8 the paper has gone through the regular heating on the driers of the paper machine. The small angular grains as seen in Figure 7 have disappeared having been altered into much larger, swollen particles which are more or less rounded. In addition, a faint blue color shows on the fibers when they are treated with a dilute solution of iodine in potassium iodide. Under this treatment the swollen starch granules do not show blue, when examined with the microscope, but are of a dull violet color.

It is plainly evident that a very drastic reaction has taken place during the heating on the paper machine. This has resulted in several changes in the starch. Firstly, the starch granules have lost their characteristic angular shape; secondly, part of the starch has gone into solution and has spread more or less uniformly over the surface of the fibers, and this reacts blue with iodine: thirdly, the remains of the granules do not show blue but give a violet color with iodine; fourthly, the swollen granules are apparently more or less hollow and, although rounded, have collapsed into irregular shapes upon being dried.

The extent to which the starch grains are altered appears to depend on the degree of heating in the presence of water. Therefore it is evident that paper containing raw or slightly modified starches will show the original unaltered grains if the paper is made with no heat; will show swollen granules with some of the starch uniformly distributed if the paper is sufficiently heated while plenty of water is present; and the starch will become only slightly swollen and distributed even with plenty of heat if there is an insufficient amount of moisture. This may well explain some peculiar results when the same starch or starch modification is used for papers in which the amount of water and the degree of heating are varied.

Effect of Heat on Starch Particles in Paper With Different Amounts of Water Present

Figures 9, 10 and 11 show the effect of heating, under the same conditions, samples of the same paper containing different amounts of water. All were heated on a metal surface held at about 300 deg. C. Only one surface of the wet paper was directly applied to the heat. The sheet shown in Figure 9 contained 37 per cent water. The starch particles are small, practically unswollen and are very dense like typical cornstarch grains. The same paper with 46 per cent moisture before being heated shows in Figure 10. Here the granules are slightly swollen but are still quite dense. Figure 11 shows the same paper but with 57 per cent moisture before heating. In this most of the granules are much swollen. Furthermore, in this paper a uniform blue color shows on the fibers near the surface when iodine solution is applied. This indicates that part of the starch has gone into solution and migrated toward the surface of the sheet. The fibers in the interior of the sheet do not exhibit this blue color when treated with the iodine. Since the swollen granules are apparently hollow it seems logical to believe that the dissolved starch has come from the interior of the granules leaving the outer part, at least, and perhaps part of the inner portion, undissolved.

These papers were heated on one side only. In the case of the sample shown in Figure 11 the surface which came into direct contact with the heat alone shows the uniform blue. The opposite side of the paper, which was not in direct contact with the heat, not only does not show uniform blue with iodine but also shows but little swelling of the granules. They appear about as illustrated in Figure 9. This condition may account in part for two-sidedness in papers since the structure of the starch may be different because of variations in moisture and in heat on the two sides during drying.

This same paper when air-dried before being heated shows neither swollen granules nor the uniform blue with iodine on any of the fibers. The starch grains are practically unaltered.

A similar paper stock handled commercially shows similar effects. The wet paper stock, when air-dried, shows cornstarch grains or clusters quite unswollen and giving a bluish color with iodine-potassium iodide solution. The finished paper, after drying on the machine, shows the starch granules greatly swollen, the same as in Figure 11 and giving a reddish reaction with the iodine solution. In addition, around each swollen particle is a kind of halo of blue and some blue shows uniformly on the surfaces of the fibers. This paper shows the starch granules greatly swollen, the same as on the other. From the evidence in the experimental work described it seems indicated that this difference is due to lack of uniformity of moisture or heat conditions, or both, between the two sides while going over the drying cylinders.

A paper made with tapioca starch shows similar conditions. The individual starch particles are swollen, react reddish with iodine and the fibers are more or less uniformly covered with starch which gives a blue reaction with iodine. This is illustrated in Figure 12.

Beater Starch Cooked to Different Temperatures

A comparison of three papers made under the same carefully controlled conditions on an experimental paper machine affords some illumination of the effect of the cooking temperatures on the structure of the starch granules. These represent some of the papers used by Weber, Shaw and O'Leary in their studies of sweet potato starch.[5] In each of the papers illustrated 2 per cent sweet potato starch was added to the beater but the starch was cooked to different temperatures before being added. In the first it was heated only to 61 deg. C. In the finished paper only unswollen, very dense, purple-black granules of starch appear, as shown in Figure 13. In the second, Figure 14, the starch was cooked to 68 deg. C. In this the granules are partly swollen, part are very dense and react deep reddish with iodine, part are dense and deep reddish with iodine, and part are light reddish, thin and apparently are or have been hollow. A very faint uniform blue shows on the surfaces of the fibers. In the third, as depicted in Figure 15, the starch was heated to 70 deg. C. This shows fewer granules but they are

almost all greatly swollen and hollow. In this paper much more starch appears as a uniform covering on the fibers giving a blue reaction with the iodine solution. Since all of these were made under the same machine conditions it is apparent that the original cooking temperatures must have had very different effects on the starch. It is further indicated that heating on the paper machine alone cannot be depended on to produce swelling, partial solution and subsequent distribution of the starch. It is still further indicated that the amount of starch which will go easily into solution and become uniformly distributed on the fibers is greatly influenced by the degree to which the starch is heated during cooking.

Relationship of Starch to Rosin Size in Paper

Figure 16 illustrates semi-diagrammatically the appearance of fiber, starch and precipated rosin size in the cross section of a sulphite paper. The rosin is in a moderately coarse form. Lee has shown in many papers containing no starch that the rosin is precipitated in a much finer form than it is here.[6] The rosin is much more uniformly distributed and is usually in thinner layers than the starch in the interior of the paper. Rosin frequently covers the fiber where no starch is present, but in parts it appears as if the starch were laid down first and that the rosin then covered the starch. The starch at the extreme surfaces of the paper gives a blue reaction with iodine solution. Most of the starch in the interior of the sheet shows as particles giving reddish reactions but the blue also shows very faintly throughout the whole sheet. The starch in this paper was probably added in the beater as a modified or cooked starch.

Migration of Starch in Paper

It has been demonstrated that, under certain conditions, starch changes its nature and position within the paper during the time of heating and drying on the paper machine driers. When the starch is sufficiently cooked before being added to the beaters a part, at least, will go into solution when the paper reaches the driers provided sufficient water is present. In some, especially thick papers, this effect may be so marked as to simulate a paper surface treated with starch. Much of the starch may be found near the surface of the sheet. With iodine this will show a uniform blue on the individual fibers as is illustrated in Figure 17. Possibly few of the original granules, even swollen, will be found. It can only be concluded that the starch has gone mostly into solution and, during drying, has migrated to the paper surfaces. When the granules do show they are usually greatly swollen, are hollow, are distributed throughout the sheet—not limited to the surfaces—and give a reddish color with potassium iodide-iodine solution. This condition is illustrated in Figure 18. Figure 19 shows a complete cross section of the tag paper illustrated in Figures 17 and 18. It is evident that in such papers, when no granules show, and especially when examinations are made without the use of the microscope, it may be impossible to tell from the distribution of the starch whether the paper has been engine sized or surface treated with the starch. The fact that starch can be seen only near the surfaces and not in the interior of the sheet is not positive evidence that the paper has been only surface treated.

Appearance of the Starch When Applied Only to the Surface

In recent years the application of starch to the surface of papers has greatly increased and in some cases it is used in preference to glue. The increase has been accelerated by the introduction of modifications of starches which afford much better results than can be secured with mill prepared pearl starch. The starch modifications most commonly used in surface applications show none of the specific structural characteristics of the starch from which they were made, at least as they are found in the finished papers. They commonly give more or less distinctly reddish colorations with iodine solutions. Figure 20 shows the surface of a sulphite bond paper with a medium amount of a modified starch applied to the surface. The appearance of the surface applied starch products varies chiefly in distribution and this varies with the amount and the conditions under which the material is applied. When only a small amount is used it may be confined to near the surfaces and may even cover them only partially with anything like a real film. This condition is illustrated in Figures 21 and 22. When much is applied, especially to papers containing little or no rosin sizing, the starch may penetrate more or less completely through the sheet and may or may not assume a film-like form. This is shown in Figures 23 and 24. It has not been demonstrated that surface applied starch products penerate into the finer structure of the fiber walls. It appears to limit itself (1) to the surfaces of the fibers and (2) to filling more or less of the interstices between the fibers. The extent to which the spaces between the fibers is filled will be proportional to the amount of starch added to the spaces that can be filled. Moreover, the dissolved or swollen starch material will always carry a large volume of water and as this evaporates the solid substance is bound to dry back to the fiber surfaces. A relatively large amount of starch will be required to form a film of any thickness which will be continuous in all directions. A complete film of measureable thickness probably does not occur in ordinary commercial papers. Usually the starch product is laid down in a manner which varies greatly in thickness and the deposits are relatively thin in parts, at least, in relation to the dimensions of the spaces between the fibers. It commonly appears in preparations made for microscopical examination that the layers are very discontinuous. Actually this is probably not so much so as appears. The apparent discontinuity may be caused by the cutting through of the sheet structure in such a way as just to remove part of the starch. Furthermore, the deposit of the starch may be so thin in some portions that it is difficult or impossible to see with the microscope and yet it may be there as a complete film.

Figures 23 and 24 show starch in a watermarked bleached sulphite bond paper. Starch almost completely fills the upper and lower thirds of the sheet while the middle is frequently without any. Sometimes the starch penetrates to form, as it were, a bridge across the middle. Obviously this condition could result only from

surface treatment. That such is the case is further indicated by the color reaction which is reddish. Figure 23 is a cross section of this paper. This shows that the surfaces of this paper are irregularly covered with starch and the surfaces of the interior fibers are likewise more or less covered. It is clear that there is no uniform, continuous, thin film such as sometimes is found in glue-sized papers, and that the starch cannot be seen to penetrate the cell walls. Figure 24 shows the top surface. In this it is even more apparent that the starch is not in the form of a uniform, unbroken film. While most of the starch reacts reddish there is some blue. Whether, in this paper, this is due to the presence of more than one starch product or because of separation of different elements of a single product is not definitely indicated. Most of the starch is irregularly spread but there are occasional grain-like masses which may indicate the presence of a small amount of beater applied starch in addition to the more abundant surface applied gum.

Figures 21 and 22 show another all sulphite, watermarked bond paper. This contains considerably less starch than the paper illustrated in Figures 23 and 24 and the reaction to iodine solution is somewhat less bluish. It is understood that only an oxidized starch was used in surface treating this paper and that no starch was added at the beater. While the top and wire sides of most papers are much alike it is not unusual to find cases where the amount, distribution and even the form of the starch vary between the two sides. In the paper illustrated by Figures 21 and 22 the starch in the wire side is more uniformly and somewhat more heavily distributed than in the top side. In another similar paper distinct grains of starch show on one side but not on the other, perhaps because of uneven drying as discussed in the foregoing.

Starch Variations in Papers Used for Same Purpose

Figures 25 to 28 are presented to show the nature of starch in papers from another point of view. In these the character of the starch is shown in four papers made for the same specific purpose by four different mills. A fifth paper made for the same purpose contained no starch at all.

In the paper illustrated in Figure 25 the starch shows in two distinctly different forms, as grains and as irregular rings. The grains stain very deeply with iodine and make it difficult to say positively whether they are very dark blue or somewhat reddish in color. The rings, which are mostly deeply convoluted or scalloped, have dense reddish outer margins which shade more or less abruptly into much lighter interiors. It can easily be conceived that these result from the drying of globules of starch suspension resulting in a separation so as to concentrate the starch in the outer part of each ring. No distinctly blue colorations show in this paper.

In the paper depicted in Figure 26 there are no granules. The starch extends irregularly over the surfaces of the fibers and gives a reddish reaction exclusively with iodine. This paper contained more starch than any of the others of this group and it is believed that the starch solution was much more concentrated than in the paper shown in Figure 25. As a result the starch could form more nearly continuously on the fibers and not dry back into such convoluted rings. This paper and the one previously described had starch applied to the surfaces.

In the paper illustrated by Figure 27 granules, which give a reddish reaction are very abundant and the fibers are uniformly, but thinly, covered so that they give a light blue reaction with iodine. Figure 28 illustrates a paper in which the starch shows only uniformly on the surfaces of the fibers and gives a pure blue reaction exclusively with iodine. In this and the last, starch was added only in the beater.

It is obvious that the types of starch products and the methods of application have been about as varied as possible in these four papers. Correlating the nature and distribution of the starches with laboratory tests and in actual use it is found that the papers show distinct differences. One of those pictured is much superior to the others. The paper made with no starch is less satisfactory than any of those containing starch.

Difficulty in Distinguishing Beater and Surface Applications

Figures 17 to 19 show how external tests to determine whether starch has been applied only to the surface may be misleading. A superficial test apparently indicates a complete coverage of the fibers with starch which reacts only blue with iodine solution. Figure 17 is a highly magnified surface view. Most of the fibers are covered, somewhat irregularly but practically completely, with starch which reacts blue. Only rarely does a reddish granule appear. Figure 18 is a similar flat view but in the interior of the sheet. Here no blue reacting starch is to be seen while the reddish granules are not uncommon. A cross section as shown in Figure 19 clearly explains the situation. This shows that only the outermost and in part the next layer of fibers is covered with the blue reacting starch. In the interior of the sheet no blue reacting starch appears, only swollen, red reacting granules. It is clearly evident that the blue reacting starch must have been in solution and migrated, during drying, to the surfaces. This starch giving a strong blue reaction uniformly over the surfaces while no blue appears in the interior could easily be mistaken for a surface size treatment. Yet this paper was only engine-sized with starch. On the other hand in a paper like that illustrated in Figure 26 starch applied only to the surfaces may penetrate in many places completely through the sheet. On the basis of distribution alone anything less than a careful microscopical analysis would indicate such a paper to be engine rather than surface treated.

In studies such as those presented by Strasser[6] and by Cobb, Lowe, Pohl and Weiss[7] it would seem that much would be added to the significance of their findings, especially in making comparative evaluations, if the exact structure and distribution of the starch products in the papers under consideration and their relationships to the fiber and other materials were shown. If, as appears reasonable to assume, the character of the starch, cooked or uncooked, modified or unmodified, alters the effect of the starch on the paper

properties, knowledge of the nature of the starch and its disposition should be of prime importance.

It is evident that starch occurs in many forms and distributions in papers. It also appears that variations in the processes of paper making may profoundly affect the structure and distribution of the starch as well as its action on the properties of the finished paper.

This article is only a brief introduction but it may serve to indicate the possibilities of microscopical methods in investigations of problems relating to the use and efficacy of starch products in paper. Such methods have the advantage of being simple, direct and rapid.

Acknowledgment

The author desires to thank the Paper Section of the Bureau of Standards for supplying him with a splendid set of papers. He also expresses appreciation to friends in the industry, who prefer to remain unnamed, for samples and data. Without the generous co-operation which has been given him, this work could hardly have been accomplished.

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(*Continued from Page 784.*)

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Growth of the Institute of Paper Chemistry

The steady progress of the Institute of Paper Chemistry, Appleton, Wis., which has gone on since its very beginning, still continues. The budget for the past year has been balanced, provision has been made for all current operating expenses, as well as reserves for depreciation and research, and it is hoped the end of the year will show a modest operating surplus. The budget for the coming year is estimated at more than $300,000, an increase of about $30,000 over the year just past. There have been gifts toward building fund in addition to substantial gifts of equipment and cash from a number of individuals, corporations and associations.

The endowment for scholarships has been increased by a fine gift of more than $10,000 and a considerable number of scholarships for the year have been provided. However, our scholarship income is still far from adequate to take care of the needs.

During the year there has been some reorganization of administrative offices and laboratory facilities to the end that the various divisions are now adequately housed as units.

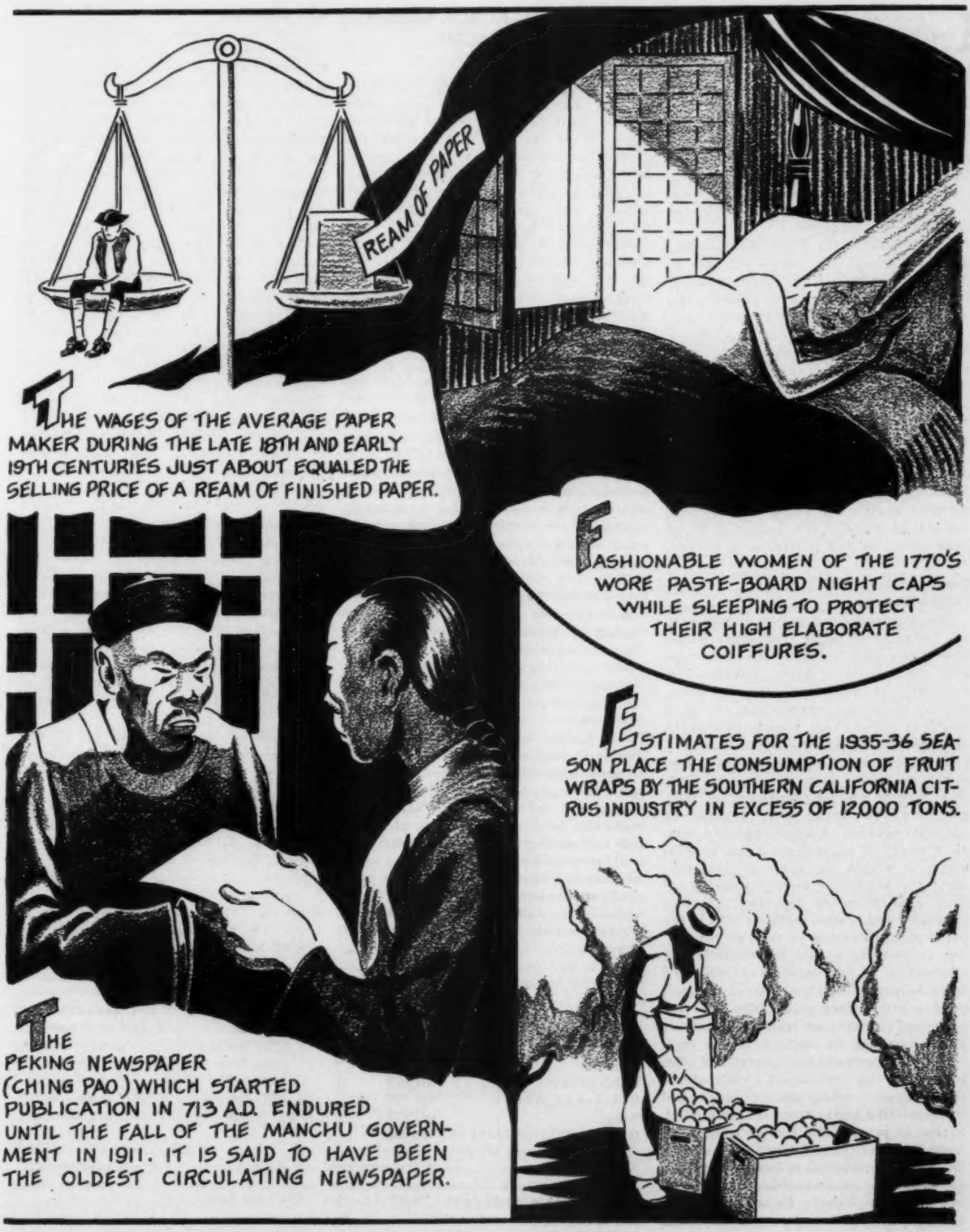
It is significant that there have been no changes in personnel, except that of director, in the major positions of the organization during the past year. We have had some turnover among technical assistants, secretaries, and maintenance staff which is to be expected. Actually we might interpret this situation as being a very constructive aspect of the Institute's service to the industry. We shall always be having young men come into the junior positions and after a few years move on into the industry greatly benefited by the training and experience they have had on our staff.

The student enrolment for the coming year is the largest in the history of the Institute and will include 47 students, an increase of six over last year. We are expecting to have 16 men in the first-year class, 13 in the second year, 9 and 5 in the third and fourth years, with 4 special students. It may be of interest to note that our present student body has been graduated from 32 separate institutions and come from 18 states and the District of Columbia. The first-year class was graduated from 15 institutions in 11 different states.

The selection of students still continues to be a matter of great importance and Dean Lewis visited 64 colleges and universities and interviewed approximately 150 students in 27 states in making the selections for the present first year class.

*Excerpt of report by Director, Thomas N. Barrows, at the annual meeting of The Institute of Paper Chemistry at Appleton, Wis., September 14.

Paper Sketches---



THE WAGES OF THE AVERAGE PAPER MAKER DURING THE LATE 18TH AND EARLY 19TH CENTURIES JUST ABOUT EQUALED THE SELLING PRICE OF A REAM OF FINISHED PAPER.

FASHIONABLE WOMEN OF THE 1770'S WORE PASTE-BOARD NIGHT CAPS WHILE SLEEPING TO PROTECT THEIR HIGH ELABORATE COIFFURES.

ESTIMATES FOR THE 1935-36 SEASON PLACE THE CONSUMPTION OF FRUIT WRAPS BY THE SOUTHERN CALIFORNIA CITRUS INDUSTRY IN EXCESS OF 12,000 TONS.

THE PEKING NEWSPAPER (CHING PAO) WHICH STARTED PUBLICATION IN 713 A.D. ENDURED UNTIL THE FALL OF THE MANCHU GOVERNMENT IN 1911. IT IS SAID TO HAVE BEEN THE OLDEST CIRCULATING NEWSPAPER.

Paper Defects....

Their Cause, Control and Cure

MURRAY M. RUBIN, Chemist
Fraser Paper, Ltd.

IN THIS day of new uses, ever increasing demand in new grades, improved quality, speedy production and resultant multiplication in defects and complaints on paper, not only from paper buyers, but also from plant operators, any discussion of the abnormalities of paper products or the pathological aspects of paper manufacturing which may elucidate their origin and aid in differentiating good from poor mill operating practices should be of interest to paper engineers and production managers.

Too frequently the plant technologist, and the practical operator as well, are so extremely traditional in their practice that they fail completely to separate the true from the false. Discriminative powers are not exercised, but dependence made on haphazard methods and self-willed procedures. Many rule-of-thumb methods prevail in spite of the application of meter stick and chemical balance. Rational procedure implies a knowledge of the origin and development, a diagnosis and prognosis, of any defects previous to recommendation of curative measures. Traditional influences have operated against the proper development and logical study of this branch of paper mills operation and control as a science.

Complaintology and Papyro-Therapy

Complaintology and papyro-therapy are two branches of paper technology which have developed recently in connection with the subject of paper defects. The first may be defined as the detection, critical study and compilation of buyer reactions reflected by reports on quality of shipments of finished paper from the vendor. In general, such converter or consumer criticisms may be good or bad. Most reports requiring investigation indicate an alleged unfavorable judgment or customer opinion. A knowledge and complete record of all such reactions to shipments is within the scope of this subject. The science of discovery and practical application of remedies, curative principles and control methods both in the paper manufacturing as well as converting or printing plants for reduction or elimination of complaints and paper defects is papyro-therapy. For these purposes every modern progressive pulp and paper mill retains at least one "trouble doctor" and service engineer on the staff.

The main purpose and interests of complaintology lie both in its purely statistical and service engineering aspects and in its relation to the treatment and elimination of paper defects. The nature and magnitude of the difficulties must be known and evaluated before any successful reduction or annihilation of defects can be accomplished. As long as we are ignorant of how a paper grade or initial order has performed during conversion or use, any treatment of complaints thereon must be purely on an empirical basis. When the final behavior of the product and customer reaction are known and understood, much greater accuracy can be attained in the treatment of paper defects. The same principle holds true for internal complaints from the mill operating staff or management to the technical control and research division of the mill with respect to materials and machine performance in pulp and paper manufacturing. The object of complaintology, then, is largely to explain and supplement any mysteries of papyro-therapy, whether the subject is studied in the laboratory, in the paper mill, or the converting plant.

General Causes of Paper Defects and Complaints

There appear to exist at least six important general causes of paper defects which result in mill operator or customer complaints or service calls. A critical study of the subject indicates that these may be enumerated and classified as follows:

Defect Type
- raw materials
- plant equipment
- processing methods
- mill operating and service personnel
- customer idiosyncrasies
- administrative policy — mill management

To do justice to all these causes would require discussion of the technical aspects of paper manufacture, control, and management by application of all the various branches of the fundamental sciences of chemistry (organic, industrial, physical) and engineering (mechanical, electrical, civil, steam, chemical and forestry). To mention also the importance of the practical papermaker in a technical discussion might invite a charge of heresy; to omit it would render this causative survey incomplete.

Raw Materials

First, there might be emphasized the relative importance of various fibrous raw materials used in papermaking from production and economy standpoints. The papermaking text books have covered the physical and chemical characteristics, general and special, of practically all the rag, wood, and grass fibers of any importance which are used in papermaking throughout the world. From the practical and statistical standpoint, it is well to remember that today, during a period of acute pulp shortage, many of these fibrous materials mentioned are still hardly more than scientific curiosities in the pulp and paper industry of North America. The accompanying table summarizes the relative importance of various pulps produced in North America in 1935.

Chemical and mechanical wood pulps then, represent 99.5 per cent of pulp production. Newsprint and kraft papers, or so-called coarse grades, comprised 67 per cent of the total fourdrinier production of North America in 1935. Wood is still the most important raw material for papermaking, and over 70 per cent of the world's present production of pulp, paper, and paperboard is manufactured from mechanical or chemical wood pulps. In the finest grades of paper the importance of alpha wood pulp and rag fibers is still of interest. Even bleached manila hemp and alpha sulphite for extra strong white bond papers have been blended by a large sulphite pulp producer recently. But seed hairs, bast fibers, plant stems and grasses used in pulp and papermaking are of minor importance compared to wood fibers.

In general, paper defects due to raw materials may be structural or functional. Improper sheet weight, caliper, density, fibrous composition, wild formation, etc., involve qualitative and quantitative defects of sheet structure. These result in functional defects such as low tensile, Mullen, tearing or folding strength; explosions, poor coverage or strike through in printing; abnormal oil, ink or wax absorption. Of the classes of paper defects, these may be considered as most widespread in news and board grades, most

	Tons—Pulp Production by Grades—1935		Per cent of Total Pulp North America
	U. S. A.	Canada	
Groundwood	1,301,721	2,603,000	44.5
Kraft	1,497,873	206,000	19.5
Unbl. sulphite	651,979	688,000	15.3
Bleached sulphite	931,537	372,000	14.8
Soda	461,878	10,000	5.4
Rags*	41,000	.....	.5
			100.0 Per cent

Total pulp production—North America—8,764,988 tons
* (fine paper consumption)

serious in fine printing, writing, and converting papers, and least important comparatively in wrapping papers.

Influence of distribution and concentration of ingredients of the beater furnish is of prime importance. To many minds in the industry paper is still made in beaters. And so, perhaps the most important factor resulting in paper defects due to blending of raw materials is incompatibility. Incompatibility of papermaking materials may be physical, chemical, or even biological. Utilization of inconsistent raw materials is due mostly to ignorance of properties and reactions of constituents of the beater furnish. Sometimes this results from the customer's ignorance, failure to specify properly or completely. To this may be coupled lack of intelligence by the mill sales division, obstinacy or poor practice in the production department, or negligence in mill administration which may result in a shipment of defective paper. Examples of this include blending of alpha and lignified wood pulps, use of dirty water supply or fillers for fine papers, use of colored natural pigments and unbleached wood pulps for light fast papers, indiscriminate application of rosin size and alum, anti-chlor in pulp bleaching, ultramarine blue in roto printing or silver wrapping papers, two-sidedness due to use of basic dyes with bleached pulps. From a technical standpoint there is as much common sense used in selecting such a pulp and color combination as in buying an expensive fur coat and trimming it with a coarse rope for a belt. This seems ridiculous, but in plant operations it continues to be done for one reason or another.

Mechanical and Process Variables

The operating variables inherent in mill equipment and processing methods for raw materials and stuff preparation as well as paper manufacturing are so numerous and so complex on modern machines as to easily confuse the average mill superintendent. Every stage of the process bristles with mechanical and chemical variables, known and unknown. Between the paper machine head box and the reel alone the average paper machine is known to possess 98 recognized operating variables. Between the woods and the shipping room only goodness knows how many variables enter into the manufacture of a satisfactory sheet of paper. When one considers that there are nine known types, 70 classes, and some 900 recognized uses for paper and paperboard products made from only a few basic raw materials, it is evident that the demand of consumers for uniformity and high quality of paper product free from defects can be met by the paper manufacturer only by close control of operations, application of rational methods, and extensive use of scientific testing apparatus.

Customer Idiosyncrasies

Complaints are received sometimes on paper defects which may be considered imaginary or hypothetical rather than real. The defect is one which exists in the mind of the customer rather than in the paper. Conditions modifying the reaction of a customer are many and varied. Such unusual reactions for which no satisfactory rational explanations can be found are classified as customer idiosyncrasies. Some customers react readily and promptly on a defective shipment of paper. Others belong to the type that do not respond easily or vociferously, but prefer to buy satisfactory goods elsewhere. Fortunately, customer idiosyncrasy is not a major phase of complaintology. To cite one example, the customer's demand was ever for more and more tensile strength in his ledger papers for ruling. Use requirements did not indicate a need of this. Investigation disclosed that paper strength was not the converter's requirement, but a strong selling point used in his resale trade. A paper defect can not be traced to a proximate cause here. Yet, to satisfy such a customer, the mill must supply what he wants and not some substitute. The highest tensile test here is none too good. Such a defect might be listed among the incurable and complaint type as chronic.

Mill Men and Management

The most important engineering factor related to paper defects and perhaps the most variable in this industry is the human element. The mill operating and service personnel represents human minds of many ages, types, and degrees of efficiency contributing practical and technical training, experience and information daily to every department of the mill organization for the main purpose of producing saleable paper. The function of management is primarily to select, train and guide such company personnel along those lines and with those policies which will result in the highest degree of co-operation and co-ordination making for product quality. The fundamental cause of excessive complaints and extraordinary paper defects, in and outside the mill is a function of mill administration.

Exact figures on extent and cure of paper defects are not obtainable. Complaint statistics compiled from an unbiased investigation of different mills, from association reports, from questionnaires among service engineers, and records of federated engineering societies reveal that, especially in those mills where the control department exercises little influence, the responsibility for defective paper is due 50 per cent to faulty mill management and 25 per cent to labor. In individual plants, there are records of paper defects which have been so severe as to become uncontrollable or pernicious, and an epidemic of complaints have resulted therefrom.

Paper Defects and Rational Mill Control

In small mills, handling of complaints on defects is cared for usually along with many other duties by the manager. Friction, embarrassment, dissatisfaction and delegation of responsibility by "buck passing" to the mill superintendent and machine operators frequently follows such procedure and little or no written records are kept for study and comment. In the larger or better managed mills the investigation and report on complaints, both operating and sales, is a distinct function of the technical research section or the service division of the department of technical control. This department makes a specialty of learning the customer and mill specifications for each grade of paper made, the use requirements involved, and is in close contact constantly with both mill and customer operations. Laboratory records of routine tests are available of paper quality made and shipped. The service engineer or "trouble doctor" in such a mill is well qualified to follow up and investigate thoroughly all complaints on plant operations or product quality. Routine testing and operating control data serve thus partly to assist in maintaining uniform product quality and trouble free operation and partly to provide a continuous record of operating statistics which will be invaluable for reference by mill management and for determination of sources of difficulties and complaints. These records, together with salesman's comments and any samples submitted, form the main body of evidence in determining the validity of complaints, exposing defects in machine or process operation that should be corrected, and individual carelessness or negligence of mill personnel which should be penalized. Such a policy and division of responsibility for quality and production make for smooth and steady mill operation with a minimum of paper defects. Where a situation cannot be covered completely by sales correspondence, customer contact can be effected by the service engineer. Responsibility for paper quality, complaints and process is delegated thereby to the technical control men, and the mill superintendent and practical paper mill operators are released to perform those duties for which they are best adapted by nature and experience and in which they are most interested; namely, superior operation of the paper machine for quality production. The establishment of such extensive technical as well as economic standards for paper quality and plant operation is one of the greatest factors which have contributed to improved quality, increased production, decrease of paper defects, and decrease of manufacturing costs.

Defect Statistics and Cost

Complaint problems and paper defects are distinctly amenable with profit to mathematical treatment. Paper imperfections and customer reactions may be classified generally as to type, geographical location, frequency, and cost. Defects may be measurable or non-measurable with testing instruments and by methods at present available to the paper technologist. Physical, chemical, microscopical, optical and special use requirement tests and methods are being used now in the industry in evaluating 50 or more recognized properties of papers and

boards. Cockles, grainy edges, and curl are a few paper defects which may be classified as non-measurable, difficult to control and of very frequent occurrence. Many others remain which are still ill-defined or non-measurable. These include printing and erasing qualities, two-sidedness, cleanliness, surface hardness, finish, formation. Types of paper defects which are easily and definitely measurable allow of qualitative and quantative evaluation, verification of customer statements, and ready solution of such complaints by elimination or control of defects. Classification, mathematical evaluation, and periodical graphical representation and summary of complaints and paper defects as indicated above yields invaluable control and cost statistics for the mill management and operating personnel. Thus, a series of complaints on curl only from one customer might indicate faulty paper seasoning or storage in his printing plant, complaints from several printers in one geographical location at one period might indicate a rainy season and high humidity there, while general complaints from many states or countries might indicate abnormalities in manufacturing on the machine or in finishing at the paper mill. The weather variable may thus affect not only customer spirits but tremendously influence both paper production and paper quality. The color of raw water for papermaking in a given district has been shown to be inversely proportional to precipitation. The same abnormal rainfall which affects paper color, brightness, cleanliness and sizing may result in excessive paper curl, waviness, and electrical stability.

Payments of valid claims may amount to many thousands of dollars annually both for defective paper and lost time in press operations. When complaints are evaluated and recorded in dollars and cents, such statistics act as a guide for direction and concentration of efforts for improvement. An investment of a thousand dollars for equipment to remove static on a high speed cutter may prove a highly profitable investment when claims of several thousand dollars annually for battered printing plates and lost time due to defective paper is involved. Briefly, complaint statistics and records of paper defects have become as important in operating economy as routine testing logs for quality and production control.

Cure of Paper Defects

It is agreed that prevention is more important than cure. In eliminating pulp and paper defects, an ounce of prevention is worth a pound of cure. When a customer has a valid claim, it is futile to speak to him of prevention of the defect in the product. Change of composition of the finished defective paper is impossible. Sometimes the shipment may be returned to the mill and further processed to produce a satisfactory prouct, such as surface or tub sizing with color a sheet originally too low in color. In some cases, it is possible also to so modify the materials and processing variables in the converting or printing plant to eliminate the defect by change of printing ink; control of pH or temperature of a dipping bath; only control of air, humidity and static. Ordinarily, defective paper results in a direct loss of time, labor, money and customer good will. In the mill, the defective product is culled and either returned as broke to the beaters to be reprocessed, or sold as job lots. After shipment, if it gets by the mill, defective paper becomes a distinct nuisance.

The aim has been to show that the complete properties of papermaking materials and steps in conversion to paper or board are coupled with many factors which are extremely complex. In general, the remedy must be fitted to the circumstances. A simple yet effective, speedy, and economical cure often requires broad knowledge, extensive experience and good judgment. Materials, equipment, process, pulp and paper mill men, and management may all be involved simultaneously in eradicating a paper defect. Briefly, successful cure of paper defects requires application of plant treatment which may be general or local.

Accordingly, the reason for proposing complaintology and papyro-therapy as independent sciences is that the simple fundamental laws of physics, chemistry, and the engineering sciences exert their influence in this branch of paper technology in a specially complicated manner. At present it is possible to analyze the entire workings of the paper machine and the products only to a limited extent. The exact synthesis of a sheet of paper and its fabrication from given raw materials and mechanical equipment by written specifications is as yet beyond comprehension.

Future Developments

The future trend of development in this science must be on a statistical and factual basis. In the files of mill technical departments, service engineers, and industrial consultants there is available a vast amount of uncorrelated but detailed factual information bearing on this subject. There are complete histories of scores of interesting cases on paper defects—their cause and cure. The Technical Association of the Pulp and Paper Industry has been accumulating such information for many years and in the TAPPI Special Reports alone are recorded over 260 papers devoted mainly to solution of paper problems, correction of difficulties, recommendations of good practices for elimination of defects in pulp and paper products. The co-operation of agencies and men to correlate, compile, and index this material will produce another interesting and invaluable treatise or text-book contributing to the literature of pulp and paper manufacture. Such a treatise could become an authoritative indexed reference manual on "Paper Defects—their cause, control and cure"—that would meet a definite need in the field of pulp and paper manufacture, and should find wide application by all concerned with operation, control, and management of pulp and paper plants.

◆ Floor Space Going Fast at Air Conditioning Show

Striking a new keynote in terms of the design of air conditioning equipment to meet the requirements of proper living and working conditions indoors during the entire year, the International Heating and Ventilating Exposition which will get under way on January 24 at Grand Central Palace, New York City, will be held under the auspices of the American Society of Heating and Ventilating Engineers.

Winter heating, long an important consideration in any building construction and air conditioning, the newer complement of modern living, are now related in interest to every phase of life and industry. It is expected that the presentation of the latest developments in these two fields will draw a record attendance at the exposition. Three floors of Grand Central Palace have been reserved and at this early date most of the available floor space has been engaged by more than 240 manufacturers. On display will be instruments to record and control all of the various factors pertaining to heating, ventilating, air conditioning and hot water heating with operation or control based on temperature, humidity, pressure flow of liquids and liquid levels. Auxiliary equipment of every type—boilers, tanks, superheaters, pumps, control valves and piping—will also be shown.

The Fifth International Heating and Ventilating Exposition is under the personal direction of Charles F. Roth, president of the International Exposition Company, who has been similarly responsible for all previous expositions.

◆ New Educational Magazine

The Institute of Industrial Arts, Gardenvale, Quebec, which, as one of its activities, has been conducting the correspondence courses sponsored by the plup and paper industry of Canada and the United States, has undertaken the publication of a monthly magazine *The Instructor.*

This magazine will pay especial attention to the development of industrial adult education, and the Credit Union movement in industry.

It will aim to help those whose ambition leads them to help themselves, acting as a medium for the exchange of ideas, and providing pertinent articles on science, industry, and social development.

Publication and editorial work will be carried on at 263 Adelaide Street, W., Toronto, and the editor will be T. Linsey Crossley, paper technologist, who has been Director of Field Work for the Institute of Industrial Arts, and is well known throughout the pulp and paper industry.

◆ TURNER HALSEY COMPANY, selling agents for Mt. Vernon-Woodberry Mills, Inc., have recently appointed the William Gray Company of Chicago, as its exclusive representatives in the states of Wisconsin, Minnesota and the upper peninsula of Michigan.

West Virginia

GOES SOUTH

WESTVACO PAPER QUALITY

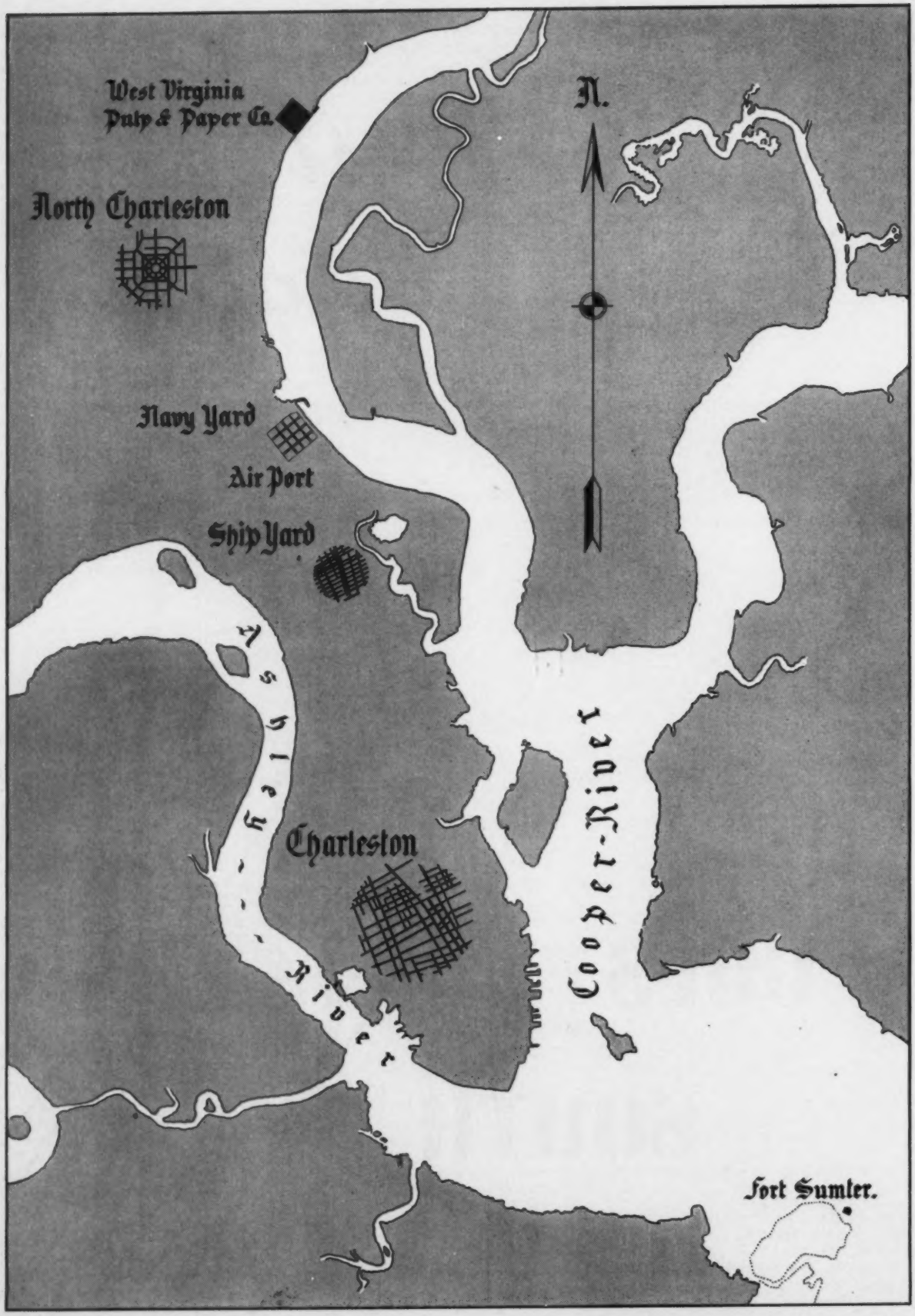

West Virginia
Pulp & Paper Co.
North Charleston
Navy Yard
Air Port
Ship Yard
N.
Ashley River
Charleston
Cooper River
Fort Sumter.

Fig. 1—Typical stand of company-owned timber.

West Virginia Goes South

HARRY E. WESTON

IT was on February 22, 1826, that John Luke in his native Scotland completed his legal apprenticeship to the art of papermaking and thus became a member of the association of English, Irish & Scotch Paper Makers. This association presented him on that day with a certificate which accredited him with the completion of his apprenticeship and gave to him all of the advantages accruing as a result of it.

At that time, little paper was made other than by hand. The fourdrinier machine had been introduced only twenty-two years before and the cylinder machine even more recently. Steam heated drying cylinders had not as yet come. Wood pulp was unknown. Modern papermaking was in its infancy.

Thus it was into this cradle of modern papermaking that John Luke began his career, and to this day descendants of his have followed papermaking as a business and a profession.

His son, William, born in 1829, emigrated about 1853-1854 to the United States, went to work in a mill near Paterson, N. J., that was run by a cousin, married the daughter of a Scotch papermaker in this country by the name of Lindsay about 1856, and afterward became manager of the mill of Jessup & Moore Paper Company near Wilmington, Del.

The story is told that while he was manager of this mill, a fire completely destroyed the paper machine, a machine that had been built by Bryan Donkin in England. To expedite delivery on a new machine, he approached an official of a foundry and machine shop in Wilmington to build it for him. The official commented that his company knew nothing about paper machines, but assented to build it after Mr. Luke informed him that he would design the machine. The machine, which was built as a result of this arrangement, was the first to be built by the concern which for years has been a leader in the building of machinery for pulp and paper mills and which has since become the Pusey & Jones Corporation.

Growth of Organization

Two sons of William Luke, John G. and David L., worked as superintendent and chemist respectively in the mill of the Richmond Paper Company at East Providence, R. I., the first concern in the United States to make sulphite pulp commercially. It was these same two brothers, financed by their father, who organized the Piedmont Pulp and Paper Company and which went into the production of sulphite pulp in the summer of 1889 at Piedmont, W. Va. Within a few months and in the very same year, Adam K., a third brother, joined them. He was followed by three other brothers, William A. in 1891 or thereabouts, Thomas in 1892, and James L. in 1895.

Expansion activities began during the latter part of 1891. At that time, a new company, The West Virginia Paper Company, was organized with

a capital of $60,000.00 to erect a paper mill at Piedmont, W. Va., on property adjoining the pulp mill of the Piedmont Pulp and Paper Company and to use the pulp from it. This mill was erected within a few months and on January 15, 1892, made its first paper. Regular operation, however, did not begin until January 20 because of delay in delivery of the electric light plant.

The West Virginia Pulp Company next was organized and a sulphite mill erected at Davis, W. Va. (*mill closed previous to* 1920). Construction work on this mill started during the fall of 1892 and the mill was put into operation in March of 1893.

The succeeding four or five years saw further expansion in the installation of four more paper machines at Piedmont; and then, about 1897, the three companies were brought together into the West Virginia Pulp and Paper Company. A year later the company combined with the Morrison & Cass Paper Company of Tyrone, Pa., a concern which had been operating a combined soda pulp and book paper mill since about 1874 and in which John G. had served as superintendent during or about 1881-1882.

Work on a combined sulphite pulp and paper mill was started during 1899 at Covington, Va. The mill included two paper machines. Pulp was made there as early as March of the following year, while the first paper was produced during the latter part of May.

In 1904, the company took over the Duncan Company at Mechanicville, N. Y., and three years later purchased a combined soda and two-machine paper mill at Williamsburg, Pa., from Charles M. Schwab, the steel magnate and associate of Andrew Carnegie for so many years.

Intimately associated with this latter transfer of property is a story that reveals the very humanness of Mr. Schwab.

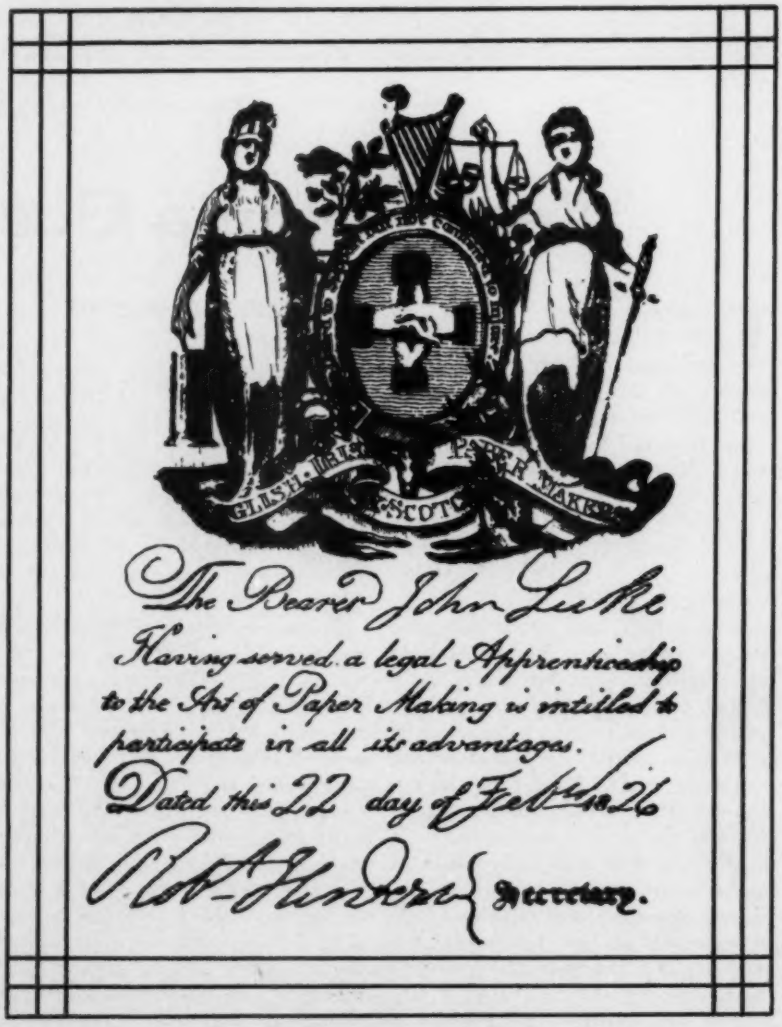
Mr. Schwab, as a boy, had lived in Williamsburg. After he had accumulated considerable wealth he wanted to do something for the town. The townspeople desired a manufacturing plant. So Charles Schwab put up the bulk of the money and a pulp and paper mill was built. The mill made no money and ran only a short time. Then it was sold to the West Virginia Pulp and Paper Company,

John Luke, first of the family of papermakers

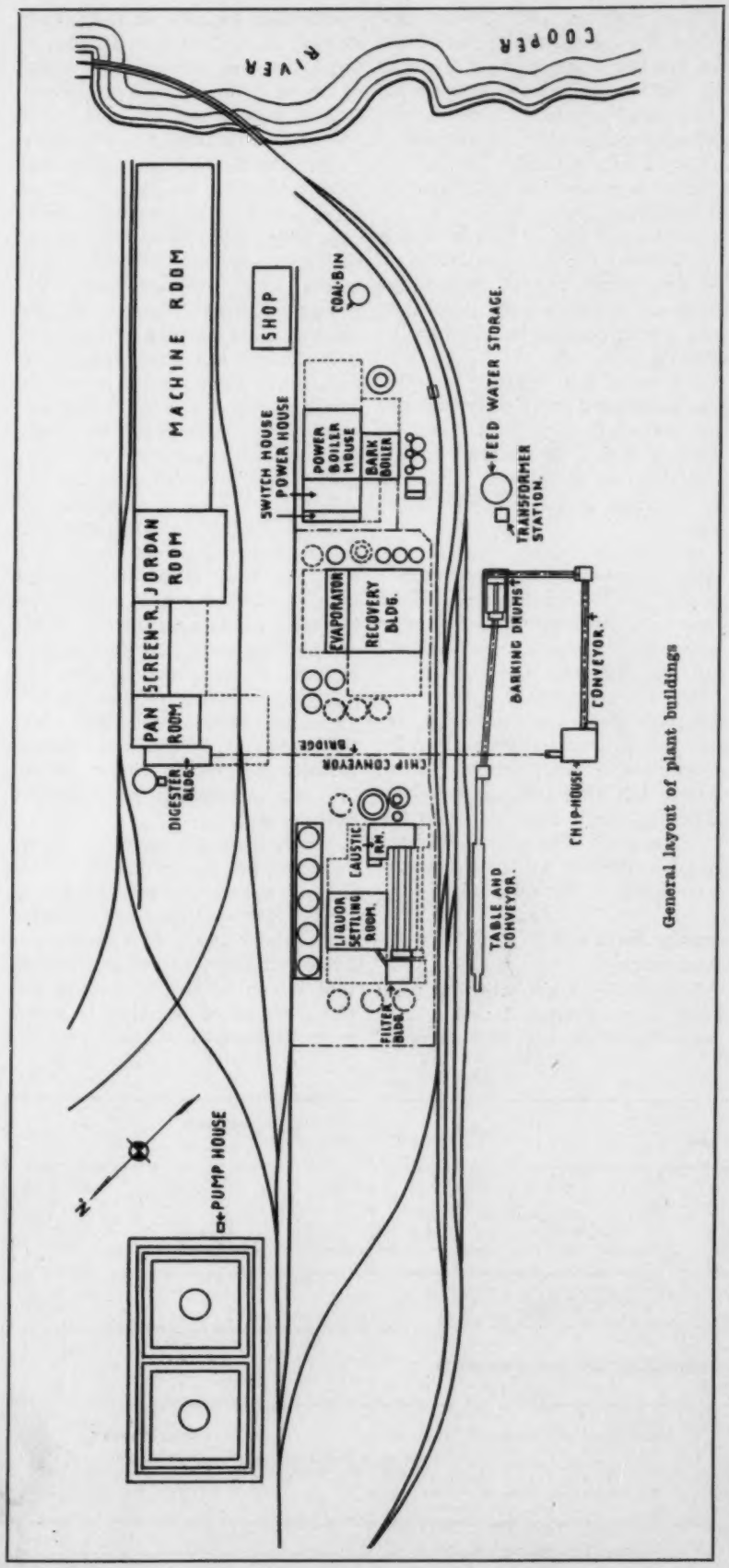
Mr. Schwab purchasing all of the stock that was owned by local people and paying dollar for dollar for it so that no one other than he lost any money on the transfer.

To assure itself of a pulpwood supply, the rapidly expanding concern purchased the nucleus of 120,000 acres of timberland during or about 1898-1899. The first timber tract actually purchased by it was in the territory south of Elkins, W. Va.

Other increases in capacity that have been made during the intervening years include the installation of two paper machines in 1907 at Piedmont; the installation of two paper machines during or about 1908 at Covington; the placing in operation of a soda pulp mill in 1921 at Covington; and the installation of four paper machines at Covington, three


The Bearer John Luke
Having served a legal Apprenticeship
to the Art of Paper Making is intitled to
participate in all its advantages.
Dated this 22 day of Feb 1826
Secretary.

Apprenticeship card of John Luke



General layout of plant buildings

fourdriniers and a cylinder, the first of the three fourdriniers in 1925, the second, a kraft machine, in 1926, the third in 1927, and the cylinder machine, a kraft board machine, in 1928.

In addition to these plant expansions, the company has been buying timberland for the last fifteen years or so in the states of North Carolina and South Carolina. The purchases, mostly in pine lands and largely within the state of South Carolina, amount to something over 300,000 acres. All of this area is protected from fire. Private roads through the various tracts permit ready access. One unit, for example, has a center line road, a cross road every two miles, and a fire line every mile each way. The roads, of course, serve as fire lines and as further protection, weather permitting, a 50 ft. strip on each side of each road is burned once a year. Then, too, there are fire lookout towers.

It probably was this forest area with its readily available pulpwood supply together with a rapidly expanding market which prompted the West Virginia Pulp and Paper Company to launch upon its most recent expansion program. This program included the erection of an integrated 350-ton mill for the production of kraft liner board.

Site of New Mill

The site selected for the erection of this mill is about eleven miles north of the heart of the City of Charleston, S. C., about three miles north of the Charleston Navy Yard, along the west bank of the Cooper River.

A channel in the Cooper River, dredged to the end of the mill property, and private docking facilities on the river connect the mill with the intercoastal canal and the Atlantic Ocean for water shipments. Three railroads, the Seaboard Air Line, the Atlantic Coast Line and the Southern Railway, also serve the mill. They deliver to a receiving yard and then each is alternately responsible through a mutual agreement for the shifting of cars for a month at a time within the mill yard.

Source of Mill Water Supply

The mill water supply is purchased from the City of Charleston,

which maintains two sources of supply. One source, known as Goose Creek Reservoir and developed by the City during the World War, receives its water from the Ashley River, while the Edisto River, through a pumping station, known as Hanahan's and located adjacent to Goose Creek Reservoir, is the second. This latter supply, after being only partially developed, was placed in service in 1931 and it was not until the building of the mill that work on the project was completed.

To get the water from the city system, the mill erected a pumping station about four miles from the mill site but immediately adjacent to both the pumping station and Goose Creek Reservoir of the City of Charleston. This station, receiving its water from either source but commonly from the Edisto River supply, delivers it to a reservoir a little over a mile from the mill and from which it flows by gravity to the mill, or the reservoir may be by-passed and the water delivered to the mill direct from the pumping station.

Pumping Station

The pumping station is both attractive in appearance and unusual in design. The building which houses the pumping installation is cylindrical in shape. That portion of it that is above ground is largely of brick construction, while the portion that extends underground, the lower part of it being below water level, makes use of steel membrane lining for the concrete work to insure water tightness.

The pumping installation includes three De Laval pumps that are directly connected to General Electric motors. These pumps have a combined capacity of 50 million gallons per day. One has a capacity of 10 million gallons, a second of 15 million gallons, and the third of 25 million gallons.

In locating these pumps, space was allowed for the installation of a fourth pump, and all major piping work completed for it so that such a pump can be installed easily whenever desired.

Control of the pumping installation is obtained principally through the use of Darling valves, an S. Morgan Smith Rotovalve, a Simplex Venturi meter, an air-water service tank, and a pressure surge tank.

Both the air-water service tank and the pressure surge tank, products of the Chicago Bridge & Iron Company, are located just outside the main pumping station building and are installed horizontally.

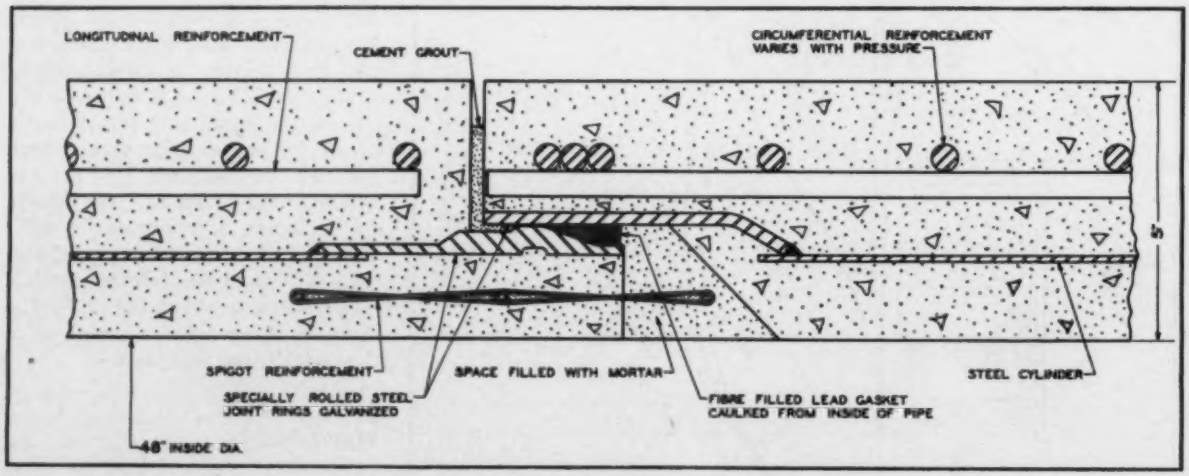
An air compressor and water pump, located in the pumping station and automatically operated by pressure and float switch control, service the air-water service tank. Likewise, air is bled from the top of this tank through a solenoid valve controlled by float switches for the top of the surge tank.

Supply Main and Reservoir

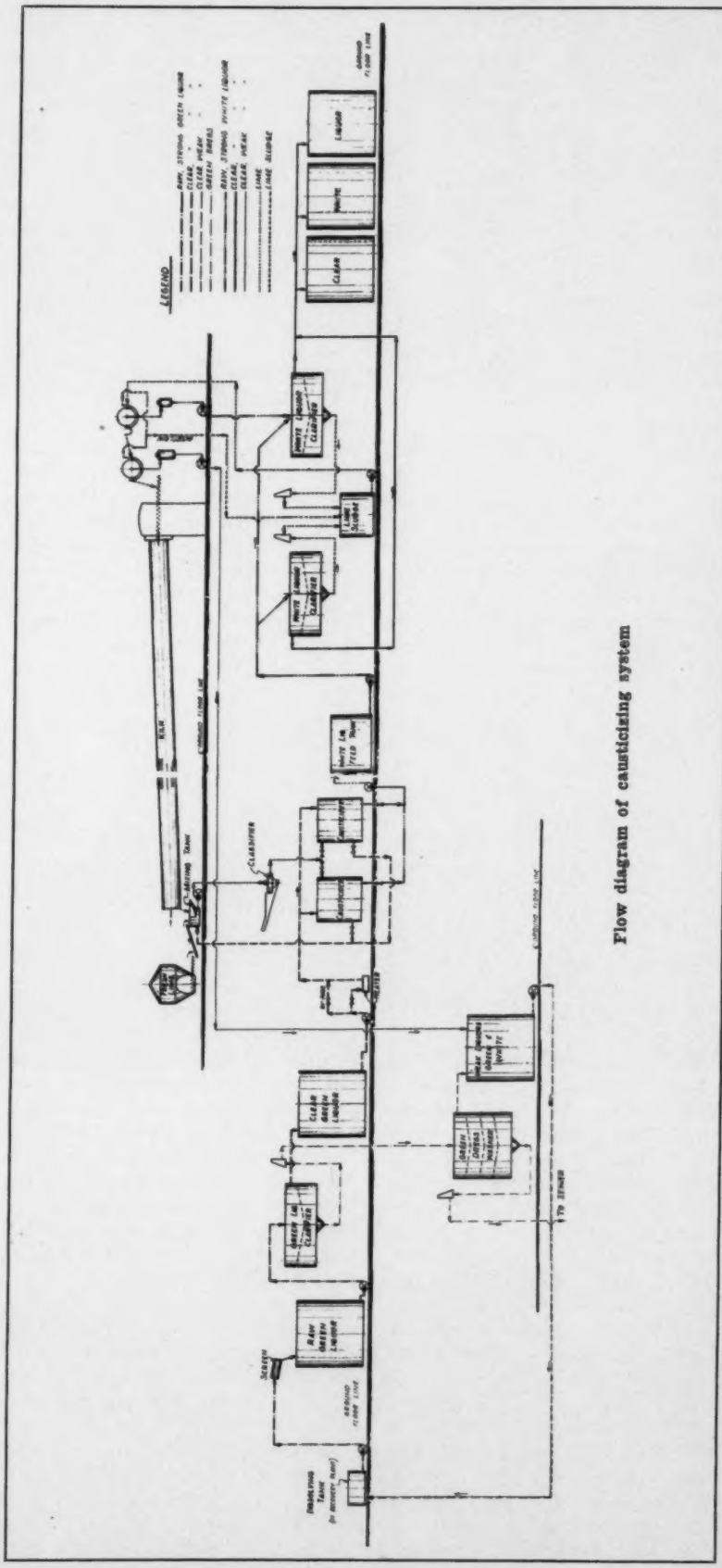
The supply main, a 48-in. main built and installed by the Lock Joint Pipe Company, is made up of twelve-foot sections of electrically welded steel cylinders which are lined with one and one-half inches of concrete and covered on the outside with three and one-half inches of concrete reinforced with steel bars both circumferentially and longitudinally. Joints are formed by special steel rings welded to the ends of the twelve-foot sections and so shaped as to form a wedge-shaped recess when two adjoining sections are brought together. Wedge-shaped, soft, preformed lead gaskets caulked into these recesses by hand from inside the pipe seal the joints, while a cement filling, applied to the recesses after the caulking operation, gives a smooth unbroken surface to the pipe interior.

The reservoir has a capacity of 10 million gallons and is formed by an earth embankment lined with concrete. It is rectangular in shape and is arranged so that water from the main enters near the end of one of the long sides in a line of flow parallel to adjacent shorter side and then is baffled to quiet the flow as it distributes itself throughout the reservoir. This arrangement permits the reservoir to serve not only for storage but as a settling basin as well.

Water from the reservoir, before delivery to the mill, is passed through one of two pressure screen tanks. Both of them are installed horizontally and within each one is a fine cylindrical screen so arranged that it can be backwashed in sections whenever cleaning is necessary. The system of control for the



Water line piping details



Flow diagram of causticizing system

tanks makes use of Chapman valves.

Water Characteristics

A typical analysis of Edisto River water as delivered to the mill reveals the following characteristics:

Total solids	75.9 p. p. m.
Volatile & organic	40.6 " " "
Insoluble SiO_2	9.2 " " "
Iron & Al. (asFe_2O_3)	2.1 " " "
Calcium (asCaO)	12.4 " " "
Magnesium	Trace
Chloride	3.5 " " "
Sulphate	7. " " "
Color	105
Odor	Fishy
Turbidity	10
pH	7.7
Methyl orange alkalinity	21.6 p. p. m.
Suspended matter	Low
Total hardness (Calculated from Ca. & Mg. Contents)	30 to 35

Mill Grouping and Construction

The mill buildings are grouped conveniently for the flow of materials. In one group is the digester building, pan room, screen room, jordan room and machine room. The evaporator room and recovery building constitute a second group; the caustic room, liquor settling room, and filter house a third; and the main boiler house, power house, switch house, and bark boiler house a fourth. As part of the grouping as a whole, but not grouped collectively, is the chip house, water treating plant, and machine shop.

About 18,000 untreated pine and cypress piles, averaging 45 feet in length, were driven for the support of foundations for the various buildings and for heavy machinery. Approximately 4,000 to 4,500 tons of steel work went into the construction of the buildings. H. H. Robertson protected metal was used for all siding and roofs with the exception of the machine room and power house. The machine room siding and the power house siding is of tile, the product of National Fireproofing Company, and has Owens-Illinois glass blocks inserted in it in the form of panels for natural lighting.

Each of the glass blocks in the panels, 16,000 of them being used, is 7¾ in. square; has ½ in. ribs run-

ning vertically on both interior faces; and transmits 84 per cent of the light.

Southern pine is the wood used for pulping. To date none of it has been cut from company owned lands since an ample supply has been and is being obtained from private owners. This wood, cut to five foot lengths, is delivered to the mill by rail and truck. Barge delivery also is possible but no such delivery has yet been made.

Wood Handling and Chip Preparation

A two-chain conveyor of very sturdy design, designated as a log table, receives the wood from the railroad cars and trucks. This conveyor is equipped with Rex Z-Metal Durobar chain with K21 riveted steel attachments. The trough is of plate steel and is broadly U-shaped.

Wood from the log table is delivered over a system of transfer conveyors, first, to the barking drum installation and, then to the chip house. There also is a system of wood handling conveyors for such wood as is in storage.

The barking drum installation includes two D. J. Murray units which are located in parallel upon a heavy concrete foundation and are unhoused. Both drums are belt driven through individual motors and Rockwood drives.

The major equipment of the chip house includes two 96-in. D. J. Murray chippers, two Orville Simpson Rotex chip screeners, two D. J. Murray chip crushers, and a Bridgeport knife grinder. The knife grinder, installed primarily for the grinding of the knives of the chippers, is located on the ground floor; while the chippers are located on the top floor, the chip screens on a floor below the chippers, and the crushers on a mezzanine between this level and the ground floor.

A parting table at the discharge end of the transfer conveyor that delivers the wood from the barking drums to the chip house leads it into one or the other of the two chippers which are individually connected to a G. E. motor. Likewise, the hood of each chipper is connected through an exhaust duct to a Claridge fan for the removal of any wood dust that might be formed during the chipping operation.

Discharge from the chippers flows by gravity to the chip screens, the top and bottom screen surfaces of which are clothed with an individual steel wire screen.

Rejects from the screening operation discharge to a Robins belt conveyor which delivers them to the two D. J. Murray chip crushers.

The Chip Conveyor

After the oversize rejects have been reduced in size by a passage through the crushers, they are conveyed along with the selected chips to the chip loft.

The conveyor bridge which connects the chip house with the digester building and which supports the chip conveyor for a good part of its length is inclined at a convenient angle that levels off horizontally toward the top as it approaches the digester building. The bridge is not covered but the conveyor itself is protected by an inverted U-shaped hood of Toncan iron.

A traveling tripper, installed within the chip loft as part of the chip conveyor installation, discharges the chips from the conveyor belt into the chip bin. The bin is U-shaped and of plate steel construction. Spaced across the bottom are five gates, through which the chips are fed to five Hedges-Walsh-Weidner welded steel digesters. One of two movable hoppers connects each gate with its respective digester.

Digesters and Cyclones

Each digester has a capacity of about 4,000 cu. ft. and is equipped with a Morris centrifugal pump for circulating the liquor during the cooking period. There also is a Foxboro recording instrument and a dual system of blow valves for each digester. One blow valve, a Pratt & Cady, which operates through a Philadelphia Gear Limitorque control, connects directly with the bottom of the digester. The second, a hand-operated Chapman valve, is located in the blow line some few feet from the first for emergency use.

All digesters are heated with direct steam.

On the roof of the pan room are four cyclones which receive the blows from the digesters and allow for separation of stock from vapor The vapor is piped downward through a common header on the outside and at one end of the digester house to a condenser; while the stock drops by gravity through a swivel pipe arrangement, one for each cyclone, into one of twelve wash pans in the room below for pulp washing.

Both the cyclones and the diffusers are products of the Chattanooga Tank & Boiler Company. The Foster Wheeler Corporation furnished the condenser.

Digester Blow Condenser

The condenser is a direct contact unit of the horizontal type. Along the top are two vents, two water inlets and a steam inlet. The steam inlet is centered at the top while one water inlet and one vent are spaced on each side of it at a center distance of four feet and six feet respectively. In the bottom of the condenser are two water outlets. The center distance between these outlets is 12 ft. while the center distance of each outlet to its respective end of the condenser is three feet.

Digester blow vapors enter the steam inlet at top center and pass down through the shell where they are directed to each side of the unit. As these vapors rise, they meet cooling water which enters the condenser through the two water inlets at the top and passes through a perforated distributing tray down over redwood heating sections. The heated water then falls through the two 24-in. water outlets directly into a storage tank upon which the condenser is mounted while the vents discharge the non-condensible gases.

This unit is designed to condense all steam generated when digester is blown to atmosphere in a period of 10 minutes. It is estimated that the heat recovery is approximately 21,500,000 B.t.u.'s per blow when water enters the condenser at the rate of 55,000 gallons in 10 minutes.

Immediately adjoining the blow condenser and hot water storage tank arrangement is a condenser installation for the recovery of crude sulphate turpentine from digester relief during the cooking cycle.

Hot water from the blow condenser storage is used for pulp washing.

Pan Room Layout

The twelve wash pans in the pan

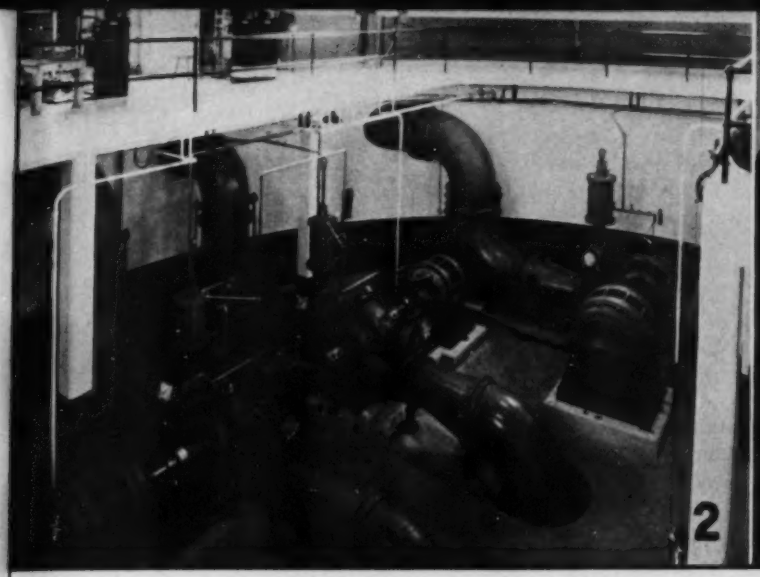


Fig. 2—Interior of pumping station. Fig. 3—Pumping station tanks. Fig. 4—Earth-embankment concrete-lined reservoir.

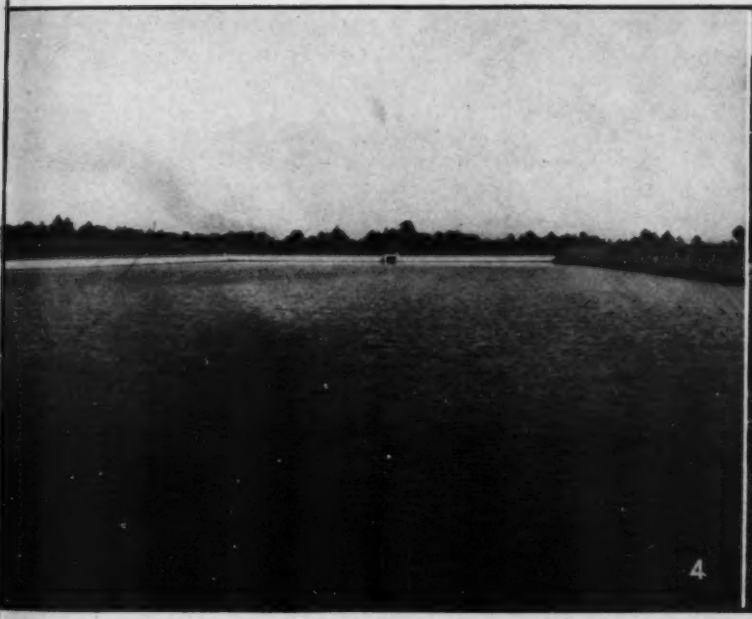


Fig. 5—Pressure screen tanks for water filtration. Fig. 6—Trainload of wood in mill yard. Fig. 7—The log table.

room are arranged in a rectangular formation of four rows of three each. Each pan will hold 51,000 gallons.

At an elevation above the tops of the wash pans on a mezzanine within the pan room in an area adjoining the digester building are four preheating tanks, while below the bottoms of the wash pans and within the pan room building are located two stock chests and two black liquor tanks, one for strong black liquor and one for weak. Like the black liquor tanks, the stock chests are of plate steel construction, but each stock chest has a rounded bottom.

On the operating floor just over the top of the strong black liquor tank is a Vallez filter for eliminating fiber and other suspended matter from the liquor. This filter, made by Goslin-Birmingham Manufacturing Co., Inc., is of the cyclic pressure type and is distinguished by completely closed operation throughout the cycle. It makes use of Monel metal cloth on the leaves, and the filtrate is returned through it until it runs clear. Manual operation is small and limited to the opening and closing of valves.

Auxiliary pumping equipment in the pan room building, located on the ground floor level, the level at which the stock chests and black liquor tanks are installed, include two stock pumps, one for each of the two stock chests, and one each for each of the following services—water, hydraulic valve pressure, weak liquor, sump, Vallez filter, black liquor to preheater, black liquor to cyclones, and black liquor to salt cake storage.

Black Liquor Evaporator

The filtered strong black liquor is concentrated in a Goslin-Birmingham rapid circulation, long tube, vertical type of evaporator. This installation, located in the evaporator room adjoining the recovery building, comprises seven bodies, three of which are grouped together, one for spare, with steam flow in parallel to form the first effect. The arrangement of vapor and liquor piping on the remaining four bodies permits any one of them to be cut out of service, thus allowing the other three units to operate in conjunction with the first effect as a quadruple, or all four effects may function along with the first as a quintuple.

Special entrainment separators are provided to handle the vapors which are flashed from each steam chest to the succeeding body under automatic control. Likewise, there is automatic control of the pumps which transfer the liquor in backward feed through the evaporator. The concentration of the liquor as it is discharged from the first effect is about 55 per cent solids.

The evaporator contains 13,500 sq. ft. of net effective tubular heating surface.

Recovery Plant

Major equipment in the recovery building for the handling of the concentrated liquor from the evaporator includes three Murray-Waern 100-ton chemical and waste heat recovery units and one B & W Tomlinson process unit.

Each of the three Murray-Waern units, individually designed for 600 lb. steam pressure and 750 deg. Fahr. total steam temperature and with a capacity of 25,000 lb. of steam per hour, is controlled through the use of Republic instruments.

The instruments for each unit are grouped conveniently on one of three panels. One of these instruments, a 10-unit multi-point indicator, indicates air pressures at each nozzle of the furnace and secondary air within the furnace on a total of six of its scales. The other four scales show draft in the smelter, draft at the outlet of the economizer of the waste heat boiler, evaporator scrubber outlet draft and gas temperature at the outlet of the economizer. The gas temperature at the outlet of the economizer also is recorded by one pen of a two-pen circular chart recording instrument, the other pen recording steam temperature.

Another two-pen instrument records flow of primary air and flow of evaporator scrubber gases, while a third, equipped with two integrators, records flow of steam from the unit and flow of heavy black liquor to the fuel jets. The black liquor flow meter from which these latter two recordings are taken is of the pressure separation type, designed to prevent the black liquor from solidifying in the pressure connections and to create a pressure differential proportional to that produced at the meter orifice in the pipe in which the flow is measured.

Each panel likewise is equipped with a pump speed indicator for the black liquor pump and a push button control for the induced draft fan dampers. There also are indicating pressure gauges to show feedwater pressure for recovery boilers, waste heat boiler drum pressure, smelter boiler drum pressure, and pressure at the main steam header into which the recovery units feed steam at 600 lb. per sq. in. and which carries the steam produced by the recovery units to the main 600 lb. manifold in the power boiler room.

The B & W Tomlinson unit consists of one B & W three-drum waste heat boiler with loop-tube superheater, return-bend loop-tube economizer, air heater, and Bailey water-cooled black liquor furnace. The boiler has 9,672 sq. ft. of heating surface and is designed for a steam pressure of 600 lb. per sq in. and for a total steam temperature of 700 deg. Fahr.

Auxiliaries to the unit include a spray tower, mixing tank, Bailey metering and control equipment and Diamond soot blowers.

Equipment for Caustic Liquor Preparation

The general arrangement of the equipment within and without the group of buildings which together constitute the caustic liquor plant is shown in the accompanying plan.

Just outside of the causticizing building, in the area between it and the recovery building, is a 30 ft. by 30 ft. clear green liquor tank. In the same area, and immediately adjoining, are two other tanks, one for oil storage and the other for lime. The oil storage tank, 16 ft. in diameter and 13 ft. high, has a capacity of 20,000 gallons; the lime storage tank, 17 ft. 6 in. in diameter, a capacity of 90 tons.

Arranged in a straight line close to the side of the liquor settling room nearest the digester building and the same side of the caustic building are five storage tanks. Each of these tanks has a diameter of 30 ft. and a height of 30 ft. One of these tanks is for weak liquor, another for raw green liquor, and the remaining three for clear white liquor.

Within the causticizing building, which houses the discharge ends of two rotary lime kilns, are two lime

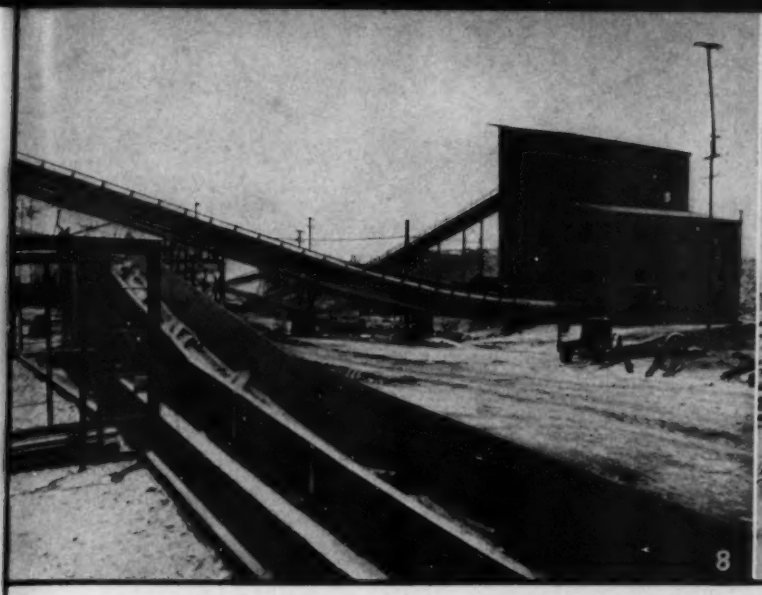


Fig. 8—Chip house showing network of wood handling conveyors. Fig. 9—Barking drums from discharge end. Fig. 10—Chipper installation.

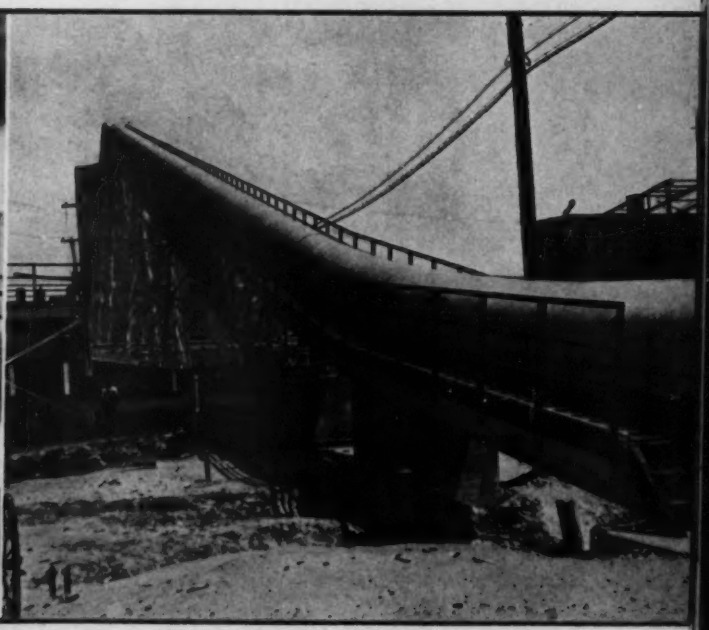


Fig. 11—Chip conveyor bridge showing conveyor housing. Fig. 12—Chip loft. Fig. 13—Digester charging floor.

mixing or slaking tanks, one for each of the kilns, a Dorr bowl-type classifier and two causticizing tanks. Each of the lime mixing tanks is 8 ft. in diameter and 5 ft. high. The classifier is 2 ft. wide by 21 ft. 8 in. long, and is equipped with an 8 ft. bowl. Both of the causticizing tanks are individually 30 ft. in diameter and 30 ft. high.

The equipment of the liquor settling room includes a trommel screen, a green liquor clarifier, a dregs washer, a white liquor feed tank, two white liquor clarifiers, and a lime sludge tank.

The trommel screen, used for the coarse screening of raw green liquor, is a 3 ft. by 6 ft. unit with ⅛ in. openings.

A Dorr two-compartment type tray thickener is used for the green liquor clarifier and for each of the two white liquor clarifiers. The dregs washer, also a Dorr unit, is a washing type thickener with four compartments.

The filter building, which completes the group of buildings comprising the caustic plant, houses three Impco filters and the feed end of two Traylor lime kilns, the kilns extending uncovered and in parallel along the side of the liquor settling room opposite to that along which the liquor storage tanks are located and ending within the kiln discharge room of the caustic building.

One of the Impco filters, the primary filter, is an 8 ft. by 8 ft. unit. The other two units are each 8 ft. by 6 ft.

The lime kilns are individually 8 ft. 6 in. in diameter and 170 ft. long. They are oil fired, and each of them, in addition to its refractory lining, is equipped with drag chains for about the last 20 ft. at the discharge end.

A common stack serves both kilns. It is located between them close to the inlet end and outside of the filter building.

Near the filter building, on the side opposite to that of the rotary kilns, is an installation of equipment for the crushing and washing of oyster shells. This installation, made out-of-doors, consists primarily of a system of conveyors, a roll type crusher, and a Traylor trommel-type washing screen.

Flow of Materials in Caustic Plant

The flow of materials through the caustic plant is shown in the accompanying flow diagram. All of the operations involved in the procedure are continuous with the exception of that of actual causticizing which is carried out in batch.

Raw green liquor from the dissolving tanks of the recovery plant is pumped to the trommel screen in the liquor settling room, where it receives a coarse screening and then flows by gravity to raw green liquor storage. It is then pumped from storage to the green liquor clarifier, from which, after clarifying, it flows by gravity to storage. The underflow from the clarifier, in turn, is pumped to the dregs washer, where the dregs, by countercurrent washing, are washed clean and as underflow are delivered to waste. Overflow from the dregs washer, on the other hand, flows by gravity to weak liquor storage.

The clear green liquor is pumped from storage through an Alco heater, or by-passed around it into one or the other of two causticizers. It is then circulated batch by batch through the lime mixing or slaking tanks, the classifier, and the causticizer which contained it until the desired strength of liquor is built up.

Such new lime as is required for the reaction is obtained from storage or in admixture with the reburned lime from the kilns. Grit retained by the lime used in causticizing is removed by the classifier.

Gravity flow is used between the causticizers and the lime mixing tanks and between the classifier and the causticizers, but pumping is required between the lime mixing tanks and the classifier.

A batch of liquor, when of the proper strength, is pumped from the causticizer to the white liquor feed tank in the liquor settling room and from this tank, which is equipped with a paddle type agitator to keep the lime mud from settling, to either of the two white liquor clarifiers. These clarifiers separate the mud from the liquor, the white liquor flowing by gravity from the units into one of three liquor storage tanks, and the mud pumped from them to the lime sludge tank.

A paddle type agitator in the lime sludge tank keeps the mud in suspension, and, in this condition, it is pumped to the primary Impco sludge filter which is located on the top floor of the filter building along with the two secondary units.

The primary filter, equipped with washing showers, discharges its cake into an agitator-equipped chamber, where water is added and the cake re-pulped previous to delivery to the secondary filters for further washing. Filtrate from the primary filter is returned to one of the white liquor clarifiers for recirculation; that from the secondary filters to weak liquor storage, where it is mixed with the weak green liquor from the dregs washer and together they serve as the source of diluent for the dissolving tanks of the recovery plant. The washed cake from the secondary filters, in turn, is delivered to the rotary lime kilns, one filter for each kiln, for re-calcining.

Temperatures for re-calcining range from about 900 deg. Fahr. at the inlet end to about 2300 deg. Fahr. at the discharge end of the kilns.

The calcining of the lime mud and the discharge of the re-burned lime thus produced into the lime mixing or slaking tanks completes the cycle of operation of the caustic plant.

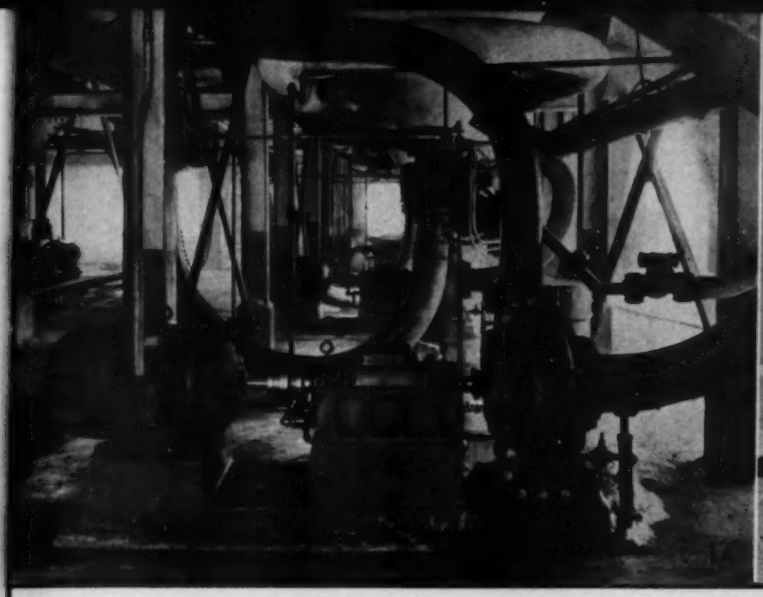
Stock Screening and Storage

At the top of the screen room are two dilution boxes to which the raw stock from storage in the pan room is pumped and in which the consistency is regulated. Both of the boxes are connected through a piping arrangement that permits stock to be by-passed from one to the other or so that both of them may function as a single unit or individually.

The two boxes discharge into a large flume above the knotters. This flume has a dam in the center of it. The dam, under ordinary conditions of operation, divides the flow so that the screen room operates in two banks.

There are two Impco knotters and three Impco screens on each of the two banks.

The rejects from the screening operation are pumped through four Noble & Wood sharp taper Bull Dog



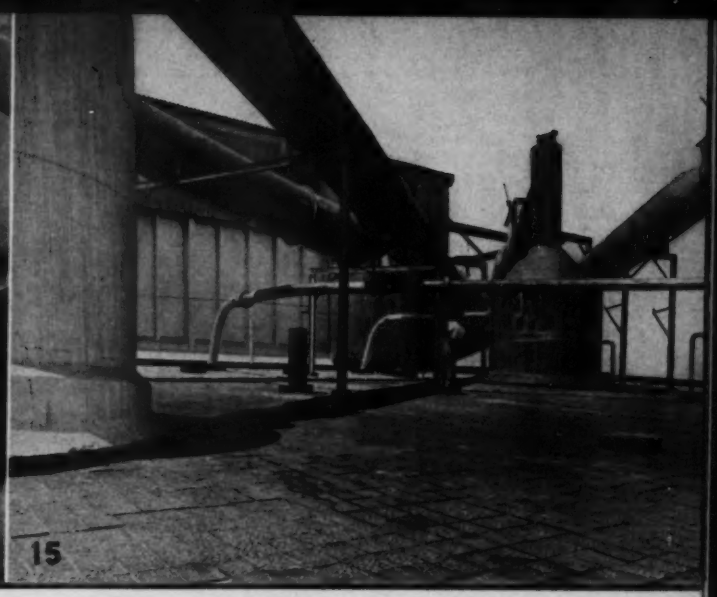
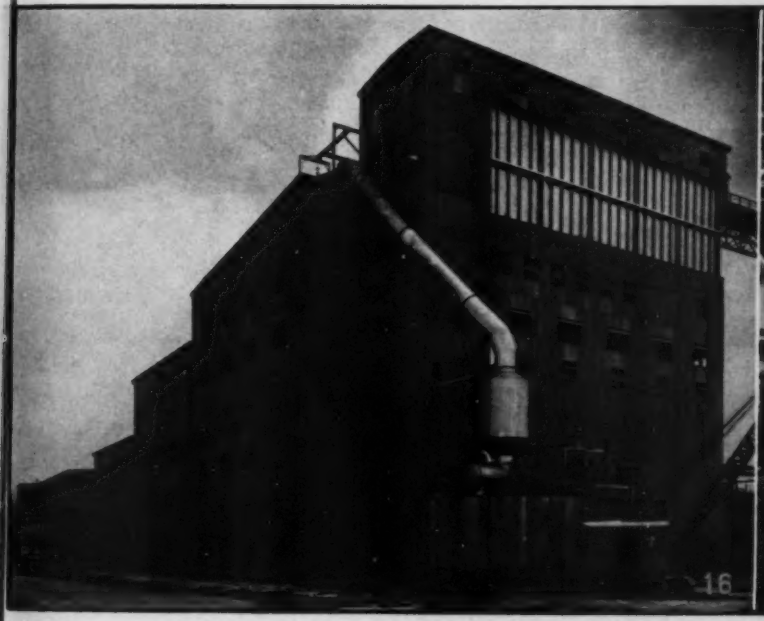


Fig. 14—Liquor circulating pump on digester. Fig. 15—Blow piping and cyclone arrangement. Fig. 16—Main group of buildings—digester building in foreground—machine room in background.



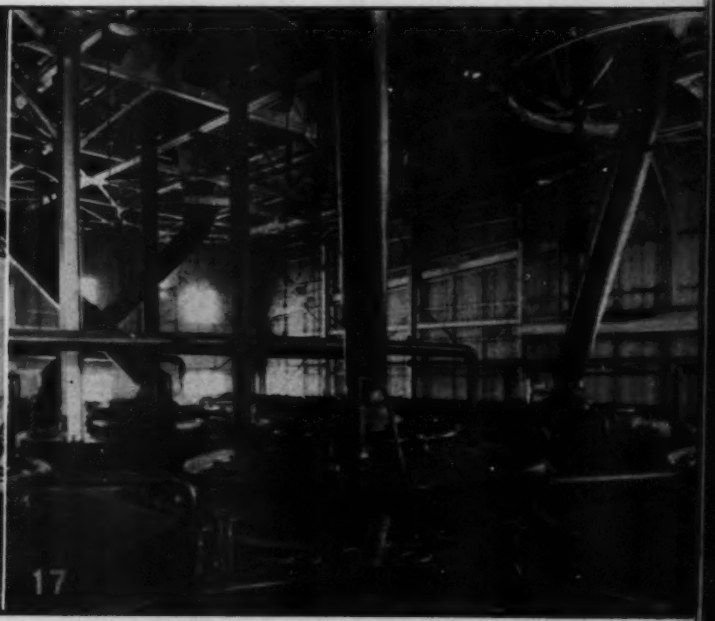


Fig. 17—Top view of part of the wash pans. Fig. 18—The evaporator installation. Fig. 19—Liquor storage tanks.

type refiners in series for reduction and the reduced fiber returned again to the screening system for re-screening.

The accepted stock from the screens drops by gravity to two Kalamazoo Tank and Silo tile chests located on the ground floor of the screen room. Each chest is equipped with a midfeather that joins the half-rounding end walls at an angle. Likewise, a Noble & Wood propeller-type agitator, direct-connected to motor through a Falk speed reducer, is installed in the midfeather at each end of the chest.

Tile used for the walls of these chests is 12 in. thick; that for the midfeathers 8 in.

Pulp Thickening

From these chests the stock is pumped to two 8 ft. by 10 ft. Impco high density vacuum thickeners where it is concentrated to about 15 to 25 per cent air-dry. Vacuum for these machines is met through barometric legs, the return water from each machine flowing through a barometric leg to storage and from which it is used for stock dilution ahead of the knotters.

The thickeners are equipped with special shredders that shred the thickened stock and then it drops into a reversible screw conveyor. This arrangement permits the stock to be delivered to a dilution chest on the ground floor where it is held at approximately 3½ per cent consistency or to two high density storage tanks of steel which are located above the low consistency chests. In this latter case, two 24 in. Robbins conveyors, each 72 ft. long, receive the stock from the screw conveyor and deliver it to the chests. This stock is removed from the chests at about 5 to 6 per cent consistency through hydraulically operated valves by the addition of water near the chest bottoms.

A 120-in. Impco three-roll hydraulic wet machine also is provided for the production of lap pulp. This machine forms the sheet on a 5-ft. diameter vacuum cylinder and presses it to approximately 28 per cent air-dry by means of three rolls which operate against the top part of the cylinder. An individually driven second press receives this sheet from the cylinder and transfers it to a three-roll hydraulic press. The sheet is delivered from this press at about 50 per cent air-dry to a rotary cutter for reduction into sheets.

The vacuum wet end and the intermediate press are driven through variable speed transmissions which provide adjustment for the draw. A totally enclosed reduction gear serves as the drive for the main three-roll press. Motive power for the entire drive is supplied by a single motor.

Jordan Room

Stock from the screen room chests is pumped to a third Kalamazoo Tank & Silo tile chest. This chest is located on the ground floor of the jordan room and is equipped with four midfeathers. None of the midfeathers join to the side or end walls but each is equipped in the center with a Noble & Wood propeller-type agitator. All walls of this chest are 12 in. thick.

The chest serves as a delivery chest to the jordans and in conjunction with a Trimbey consistency regulator supplies stock to them at uniform density.

The jordan installation consists of 16 Noble & Wood Mammoth Senior units. Each of these units is equipped with SKF barrel type roller bearings and is directly connected through a Bartlett-Hayward flexible coupling to a synchronous motor.

Size Making Plant

Tied in with the jordan installation is a Bennett size making plant for the preparation of size. The plant has a capacity of 8,000 lb. of size (dry weight) per day, and consists essentially of two melt tanks, a Bennett dispersion machine, a liquid caustic soda storage tank, a steam-heated caustic soda dilution tank, a 12-compartment thick size storage tank, three dilute size storage tanks and necessary control apparatus. Approximately 8,000 sq. ft. of floor space is given over to the installation and for the storage of raw materials.

The melt tanks, each 8 ft. by 6 ft. by 3½ ft., are heated by electricity. Twelve 3.8 kw. G. E. space heaters are installed under each of them.

The liquid caustic soda storage tank has a capacity of 10,000 gallons; that of the caustic soda dilution tank 2,000 gallons; and that of each of the three dilute size tanks 15,000 gallons. The capacity of each of the compartments of the thick size storage tank is 800 gallons.

Rosin and wax, the chief raw materials used in producing the size, are received in barrels; the barrels raised to a platform, opened, and dumped into the melt tanks; and the mixture melted. Each of the melt tanks holds approximately 10,000 lb. of melt, and approximately 8 hours are required for the melting.

The molten rosin and wax, kept at the desired temperature through the use of automatic thermometer controllers, is pumped by a small steam jacketed pump to the Bennett dispersion machine and into which the flow is controlled by a weir. A small centrifugal pump delivers liquid caustic soda of 50 per cent concentration from storage to the dilution tank where water is added to make the solution of proper strength for use in the dispersion machine.

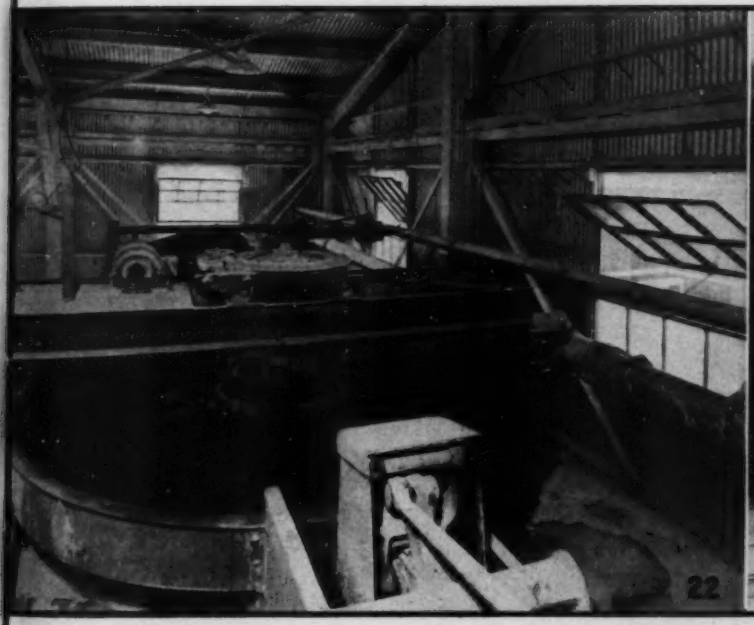
Flow of caustic into the machine is controlled by a Schutte & Koerting rotometer to which it is pumped from the dilution tank. The same rotometer also controls the amount of cooling water injected into the machine.

The dispersion machine, driven by a 2 hp. motor, has a capacity of about 4,000 lb. of size per hour. This size comes from the machine at a concentration of 30 per cent solids and is pumped to the thick size storage chest.

Each of the twelve compartments of the thick size storage chest holds 800 gallons, exactly enough to make up a 15,000 gallon batch of dilute size at 1½ per cent concentration. Such a batch is prepared by filling one of the three dilute size tanks with water, re-circulating this water with a 5 hp. centrifugal pump, and by injecting thick size from one of the compartments of the thick size storage tank into the pump intake during re-circulation.

Temperature of molten rosin and wax, temperature of caustic solution, and exit temperature of finished size are recorded simultaneously by a Brown Instrument 3-pen recording thermometer.

Fig. 20—View in recovery room. Fig. 21—A recovery room control panel. Fig. 22—Bowl-type classifier.



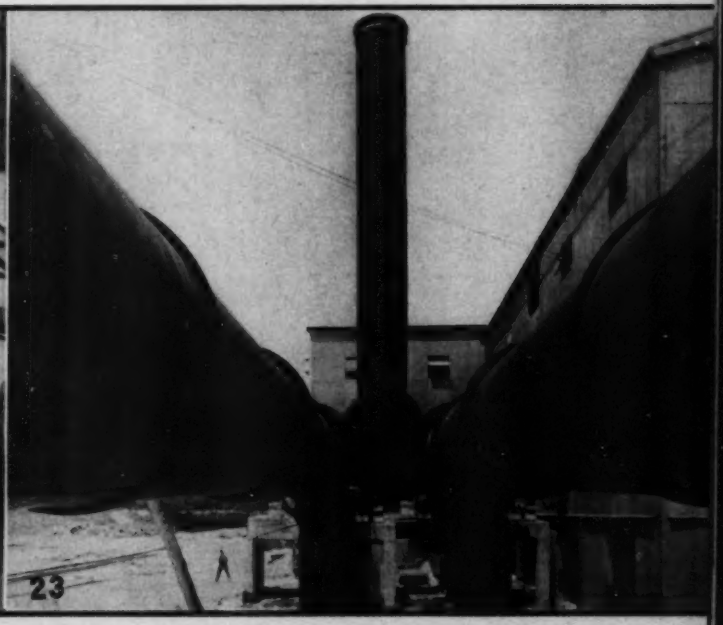
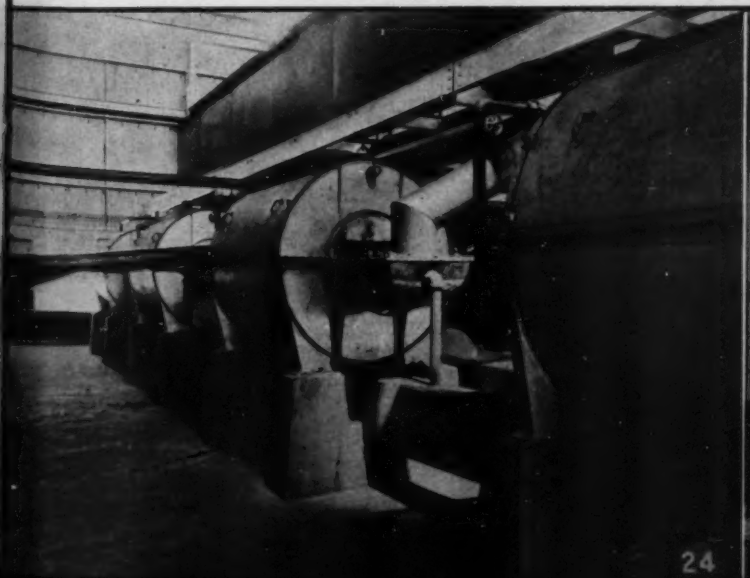
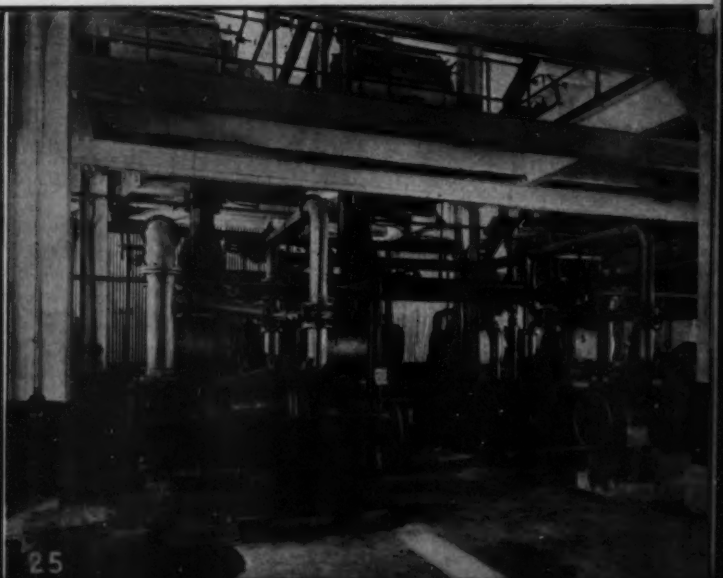


Fig. 23—Two rotary lime kilns. Fig. 24—Line of knotters. Fig. 25—Knotter reject refiners.





Machine Chests

Two additional Kalamazoo Tank & Silo tile chests, located adjacent to the delivery chest for the jordans, receive the jordan-treated stock. These chests, serving as machine chests, are similar in design but larger than the dilution chests. A midfeather extends down the center of each of them and joins the half rounding end at one end in the center and makes a right angle at the other end to join the side wall. All of the walls of these chests are 12 in. thick.

Circulation of stock as in the other tile chests is obtained through the use of Noble & Wood propeller-type agitators. There is one of these agitators in each end of each machine chest.

Paper Machine Wet End

From these machine chests, the stock is pumped to four additional Noble & Wood jordans of the same specifications as those in the jordan room but piped singly and located just ahead of the paper machine in the machine room for final treatment before fabrication. These jordans, known as tickler jordans, discharge into the intake compartment of a 242 in. Pusey & Jones fourdrinier with which is combined a two-compartment flow box.

Construction of this combination intake compartment and flow box, which is supported on a rigid structural steel framework, is of light steel plate, stainless clad on the inside, and of wood for interior partitions and baffles. Each main compartment is equipped with an adjustable baffle and each partition with removable top sections. There is a semi-circular bottom in each compartment and flow space between partitions and baffles is progressively larger in size.

A large perforated motor driven roll is provided in the flow space just ahead of the apron. This roll serves as a current breaker and stock distributor.

The fourdrinier part is equipped with a wire 242 in. wide, a 252 in. face Downingtown suction couch roll, an adjustable shake, a quick handling wire installation device, a combination type slice, and with Timken bearings for breast roll and table rolls.

The combination type slice includes a straight slice, 60 in. high and with adjustable lip that is located directly over the breast roll; a second adjustable lip slice, 24 in. high, immediately following; and a plain straight slice, about 12 in. high, following the second. Each of the slices has vertical hand adjustment. There is also horizontal hand adjustment for the second and third slices. The first slice, likewise, is equipped with a motor operated mechanism for vertical adjustment of about 24 in.

The suction boxes are oscillated crosswise and lengthwise by a motor driven mechanism that is built into the fourdrinier side frames.

A Broughton unit vacuum control system also is attached to the boxes. This system utilizes a drop leg and a Broughton controller for each box. Separation of air and water takes place in a separating tee, the bottom of which connects with the drop leg and which extends downward to a seal tank on the floor below. The top of the tee connects through the controller and a head with the couch roll vacuum supply system.

The press part is made up of a 36-in. diameter by 250-in. face Downingtown suction first press; a 36-in. diameter by 250-in. Downingtown suction second press; two 20-in. diameter by 252-in. face Downingtown suction felt rolls; and a feltless third press (smoothing press).

All heavy parts of the wet end section, such as main frames and removable beams are heavily sprayed with a coating of lead. Practically all of the light parts are made of stainless steel or bronze. Return wire rolls and press felt carrying rolls are of light steel tubing covered with Monel metal.

Such attachments as the flow box distributor roll, main slice, suction box oscillator, wire removal and draping mechanism, upper press roll lift, oscillating press doctor, broke conveyors and felt stretch of each press section have been brought under push button control through motor drive.

Dryer Section

The dryer section consists of four sections of 20 dryers each.

Each dryer is 60 in. in diameter. It is made with a shell of special close grain cast iron alloy. The shell is bored on the inside and is fitted with semi-steel heads and high carbon steel journals.

A steam joint of the oilless pressure type connects the dryer through flexible tubing to vertical steam and water piping.

Within the dryer section is a steam distributor nozzle and a syphon pipe. The syphon pipe, supported by the steam joint on one end and a special oilless bearing attached to the inside of the dryer head, may be rotated and fixed in position by means of outside adjustment.

Three hardened steel rockers support the front bearing housing in such a manner that it is kept at the same height even when displaced in one direction or the other by contraction and expansion in the length of the dryer. Side movement of the housing is prevented by guides in the base plate.

The bearing housing on the back journal is fixed.

A small diameter gear is mounted on the back journal extension of each dryer and all of the dryers in the lower tier connected in continuous train horizontally by idler gears of the same size. Each idler of this train connects vertically through a small intermediate idler with gear on the dryer above it. Two separate anti-friction bearings housed in the back frame support each of the idler gears.

Lubrication of the dryer bearings, all of which are SKF, and of the dryer gears is effected through the use of a Bowser pressure lubricating and filtering system. Overflow oil from the bearings is collected by channels cast on the inside of the gear enclosure and delivered directly to the gears. Oil draining to the bottom of the gear enclosure is filtered and cooled and returned directly into the oiling system. Filtering and oil storage equipment is located on the floor directly below that of the machine room and close to the dryer part.

Dryer Auxiliaries

A Mason-Neilan Tenso-Temp control system controls steam flow to the dryers while a Broughton drainage system with pump and metering unit handles the condensate from them.

The Mason-Neilan system includes a tension roll, a hydraulic transmission system, an air-operated temperature control instrument with tem-

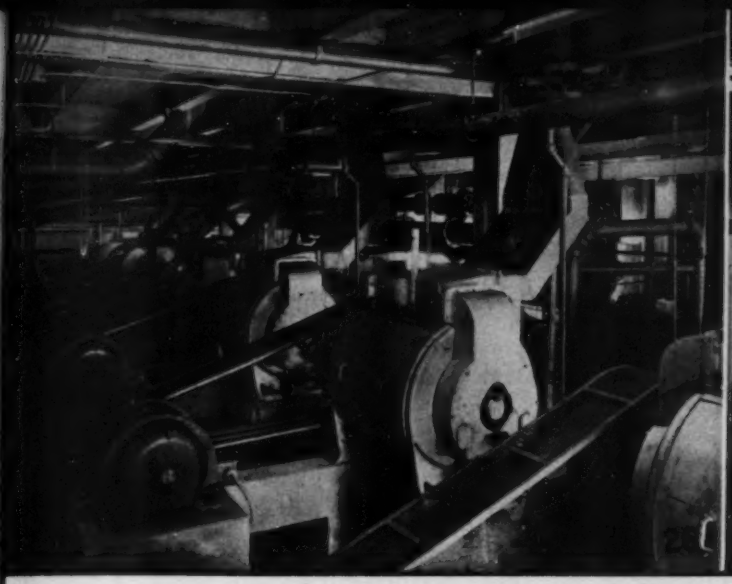
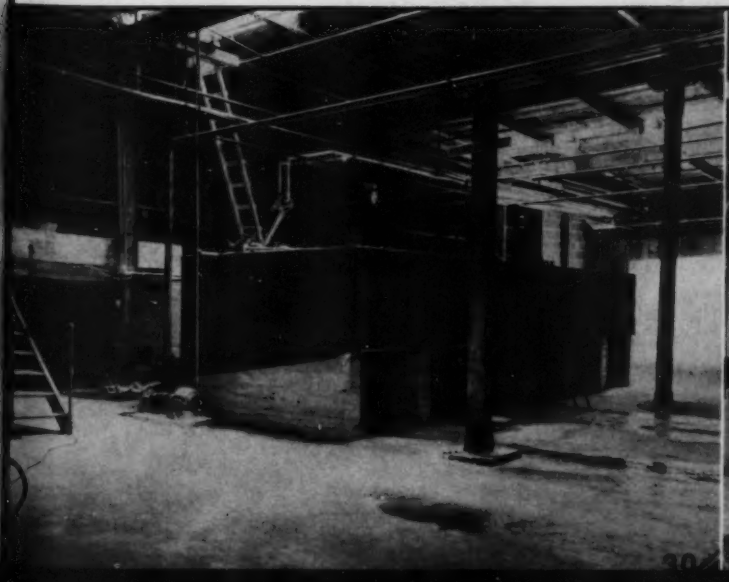


Fig. 26—Installation of screens. Fig. 27—High density vacuum pulp thickeners. Fig. 28—Three-roll hydraulic wet machine.

Fig. 29—Two rows of jordans. Fig. 30—View in size plant. Fig. 31—One of the tile-constructed stock chests.



perature bulb inside one of the dryers, and a steam control valve in the steam header for the dryers. The tension roll is in contact with the sheet and, with changes in sheet tension, actuates the hydraulic transmission system which in turn causes the set temperature to be increased or decreased sufficiently to return the sheet tension to the required point. Should a break occur, the tension roll trips out an auxiliary solenoid valve that shuts off all steam to the dryers. The tension roll is automatically brought back into position and the shut-off valve opened as soon as the sheet is again traveling over the dryers. A record of drying temperatures is made on the dial of the temperature control instrument which is placed conveniently on the dryer frame on the front side of the machine.

Syphon pipes of the Broughton drainage system are one-half inch in diameter and extend from within the dryers to the outside and downward to the return header where they terminate into it through a series of swing check valves, one for each syphon pipe. The return header is 3 in. in diameter and is equipped with thermostatic traps. These traps close against steam but remain open for air regardless of temperature.

The condensate flows from the return header into a receiver tank from which the pump of the pump and metering unit delivers it to a feedwater heater. The meter of the pump and metering unit in turn meters the condensate and permits calculation of the quantity of steam used in the dryers for any quantity of paper.

The dryer part also is equipped with a Ross panel type hood. This hood is approximately 250 ft. long and is connected to seven large exhaust fans mounted on the roof of the machine room. These fans are full-housed and are driven by splash-proof motors.

Air supply equipment includes four roof units, two for the machine and two for a machine in contemplation. Specially built, standard design fans are used for these units, and welded steel pipe coils for the heaters.

Two separate units supply a large volume of air to the bottom felt of the machine. This air is delivered to the felt through cross nozzle pipes.

Characteristics of Calender Stacks

Following the dryer part are two Farrel-Birmingham calendar stacks, and a Pope reel.

Each stack is equipped with six rolls, with babbitt lined and water cooled bearings, with gravity feed oiling and with electric lifts.

The bottom roll of each stack is 34 in. in diameter; the next to the bottom roll 20 in.; the three intermediate rolls 18 in.; and the top roll 20 in. All of the rolls are 234 in. face.

The weight of the rolls in each of the two stacks is as follows:

First Stack (Next to Dryers)

Top	21,820 lb.
No. 5	17,450 lb.
No. 4	17,430 lb.
No. 3	17,480 lb.
No. 2	21,270 lb.
Bottom	64,800 lb.

Second Stack

Top	21,740 lb.
No. 5	17,550 lb.
No. 4	17,500 lb.
No. 3	17,350 lb.
No. 2	21,650 lb.
Bottom	67,750 lb.

The Reel

An oil-filled dash pot device is used in connection with the Pope reel to overcome any tendency of a jumbo roll of rough finish and uneven caliper to bounce and pound. This device, installed on each side of the reel, is connected at one end to the upper part of the arms supporting the roll core and at the other end to the sill plates.

The reel also is fitted for the attachment of an auxiliary motor drive. This drive consists of a variable speed motor that is connected through a specially designed flexible shaft and coupling with the journal extension of the core. It is for use on water finish liner when there is a tendency in the starting of a new roll for the roll core to slip in frictional contact on the main drum. The use of the drive brings the core up to paper speed prior to adjusting it in running contact with the main drum. As the roll builds up, the core transfers to the finishing position and the flexible shaft disconnects automatically from the journal extension.

Drive for Machine

The paper machine, designed to operate over a speed range of 350 to 1,400 f. p. m., is driven by a Westinghouse sectional electric drive. Included in this drive is a 1,000-kw., 250-v., d. c. synchronous motor generator set, a 300-hp. motor for the couch, a 100-hp. motor for each of the two suction presses, a 60-hp. motor for the smoothing press, a 100-hp. motor for each of the four dryer sections, a 250-hp. for each of the two stacks of calenders, a 60-hp. motor on the reel, and necessary control equipment. All wet end motors are totally enclosed and forced ventilated. Parallel shaft, enclosed, splash-lubricated, horizontal type, helical gear units connect the d. c. section motors to the intake shafts of the individual sections.

A master control cabinet is located on the front side of the machine. It is equipped with fast, slow and emergency stop buttons and a speed indicator which together permit adjustment of speed or stopping of the entire machine.

There also are control stations for each of the several sections of the machine. These stations, also on the front side of the machine, are equipped individually with start, stop, inch, and lock safe and run push buttons. The lock safe and run push button of any station is a safety feature and makes it possible to prevent the accidental starting of the section controlled by it.

Each of the motors on the dryers is provided with dynamic braking. In addition, the drive equipment is arranged to allow the four sections of dryers to be operated as a single unit with the sections geared together, or independently with the sections disconnected mechanically.

Carbon pile differential speed regulators serve every section of the machine except the reel. They are of the quick response field forcing type and are totally enclosed.

A master frequency generator, driven by a separate d. c. motor in parallel with the main sections of the machine, maintains all sections at correct relative speed with respect to the machine as a whole. The separate drive for the generator makes regulation of each section independent of any other.

Operating speed and draw of any section can be adjusted by a synchro-

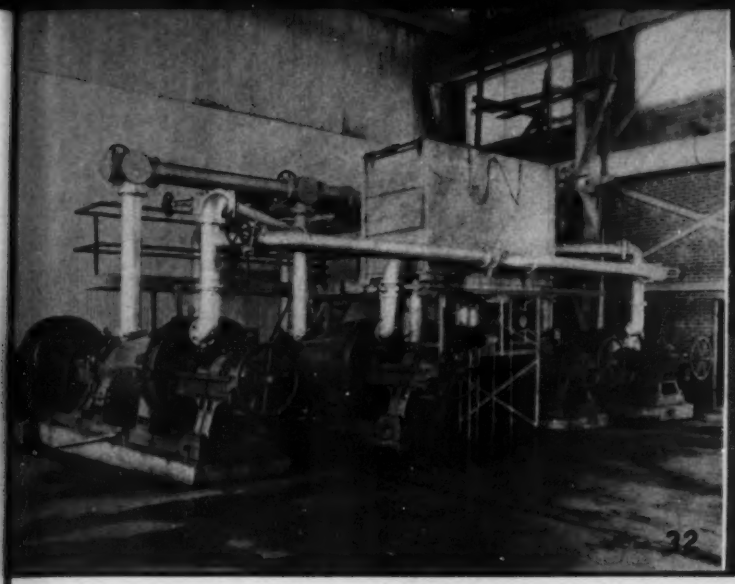
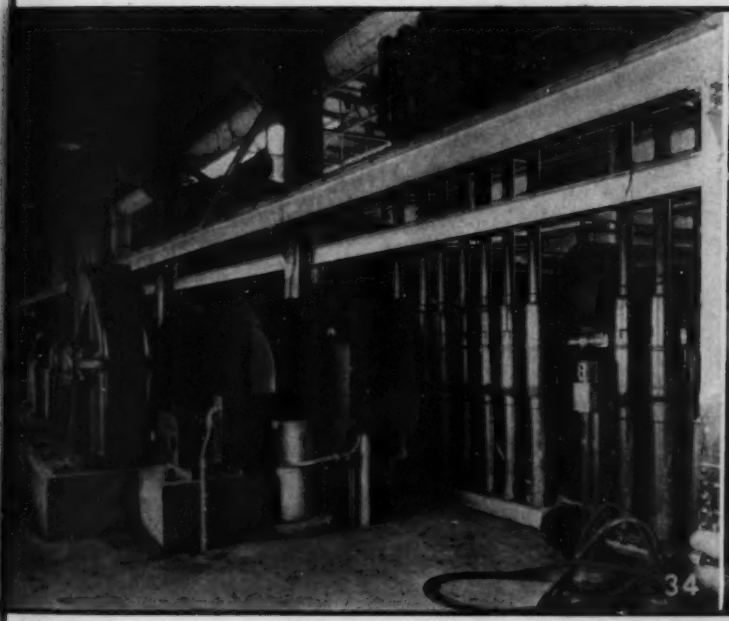


Fig. 32—Battery of finishing jordans. Fig. 33—Paper machine wet end from front side.
Fig. 34—Paper machine wet end from back side.



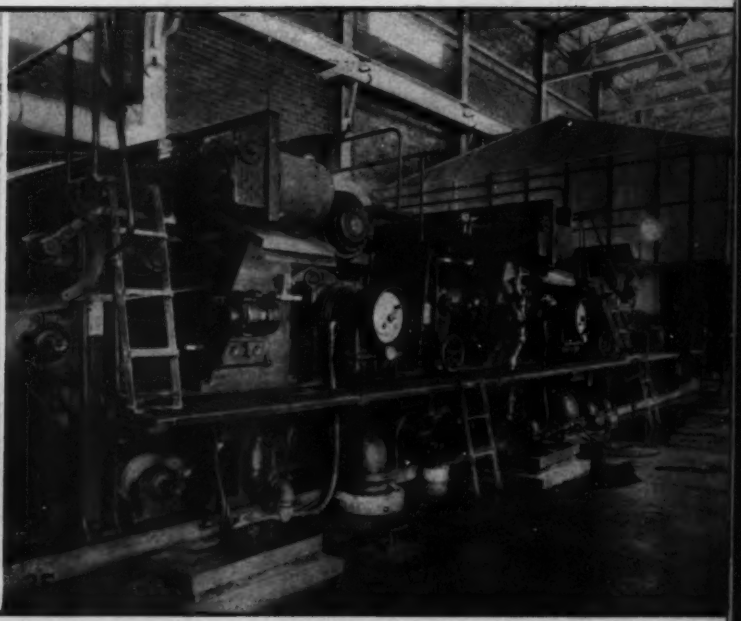
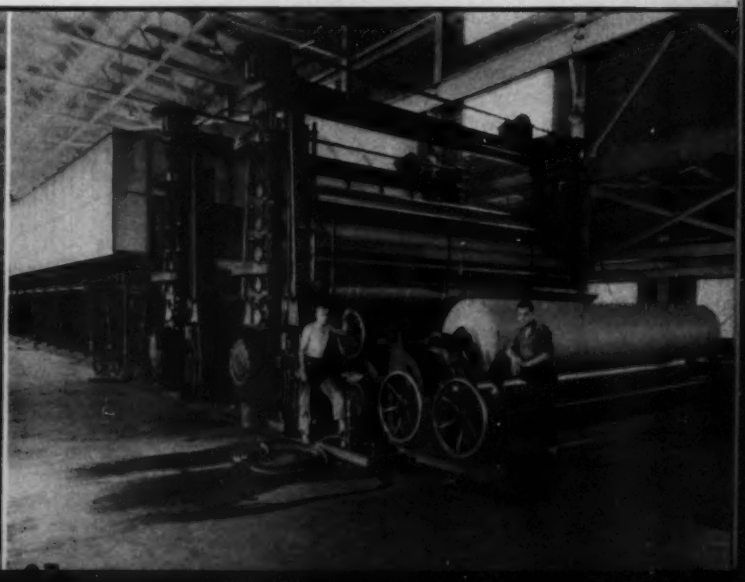


Fig. 35—Press part. Fig. 36—The dryer part. Fig. 37—Calenders and reel.



tie draw adjusting device. The device consists of a transmitter and receiver unit, the transmitter being located adjacent to the control station of the section, and the receiver at the differential speed regulator. Movement of the transmitter results in similar movement of the receiver which adjusts the belt position on the speed changer of the differential unit and regulates the speed of the section.

The motor on the reel section of the machine is designed to automatically maintain constant tension in the sheet between the second stack of calenders and the reel.

Main generator and exciter voltages are maintained with electronic type voltage regulators. These regulators make the machine speed independent of load, frequency variations, or other disturbing mill factors.

All section motors are equipped with cabinet mounted reversing knife switches and each individual section of the machine with a cabinet mounted ammeter. The reversing knife switches permit the direction of motor rotation to be reversed; while the ammeter indicates the load of the individual section and permits routine inspection of machine performance.

Finishing Room Layout

The finishing room adjoins the machine room a short distance beyond the dry end of the paper machine without a wall rising between them. The machine room, however, is at second floor level while the floor of the finishing room is only a few feet above the level of the machine room basement which is at ground level.

Major equipment of the finishing room includes a Cameron winder, a Moore & White winder, a Toledo platform scale, and a Farrel roll grinder.

The Cameron winder is installed directly in line with the paper machine. Directly opposite it, with convenient aisle space between, is the Moore & White winder.

Space behind the Moore & White winder is provided in the machine room for the installation of a second paper machine.

The Toledo platform scale is placed conveniently ahead of the Cameron winder to permit rapid weighing of the finished rolls previous to loading them for shipment. Its location also will be convenient for handling the rolls from the Moore & White winder, should such practice be desired.

The Farrel-Birmingham roll grinder is located at the far end of the finishing room on the side opposite the Toledo scale.

A Shaw Box crane of 10-tons capacity extends over the two stacks of calenders, the reel, the Cameron winder and terminates about 20 or 25 ft. beyond the far wall of the finishing room. This crane is intended primarily for delivering jumbo rolls from the reel to the Cameron winder, but it also is available for unloading materials from trucks spotted under the extension that protrudes beyond finishing room and for delivering such materials within the finishing room or to the dry end of the machine room.

The Cameron winder is a Type 20 unit with a drum face of 238 in. and a trim width of 234 in. It is capable of running at speeds up to 3,300 f. p. m. and will produce rolls up to 60 in. in diameter. When running on board, it will operate at speeds from 1,800 to 2,000 f. p. m.

Both the riding roller and the rewind shaft have automatic counterweighting.

Other features include Alemite lubrication and anti-friction bearings throughout. Both Norma-Hoffmann and SKF bearings are used on the machine.

The winder drive includes a 200-hp. winder motor, a 125-kw. induction M-G set, and a braking generator. The M-G set and braking generator are connected to the unwinding stand and both supply power to the motor.

The winder is installed in such a position that the top of the rewinding drums are on a level with the unloading platform.

The platform of the Toledo scale also is located at the level of and within the unloading platform. This arrangement permits the finished rolls from the winder to be rolled upon the platform of the scale with ease and after weighing to be picked up by a Mercury electric truck and loaded for shipment or otherwise handled for storage.

The Farrel roll grinder, a two-wheel swing rest machine, equipped with a Farrel cam type crowning device, is capable of grinding rolls up to 36 in. in diameter by 292 in. long on the face.

The grinding wheels are overhung and each is driven by a variable speed direct current motor through a multiple V-belt drive. Carriage ways are of the inverted V-type, flood lubricated, and covered by a flexible belt which excludes dirt and grit from the ways. The carriage is driven by a screw which also is fully enclosed and runs in a bath of oil. This screw and the roll drive, like each of the grinding wheels, are individually driven by a variable speed direct current motor.

Water Treatment for Boilers

Approximately 1,000,000 gallons of water per day are required to meet the needs of the several boilers, including those which are installed in the recovery plant. All of this water is treated with ferric sulphate (Ferrisul) coagulant and filtered for clarification. Then it is treated with other chemicals for boiler water control.

Two upward flow mixing, coagulating and settling tanks, each 20 ft. by 35 ft., receive the raw water treated with ferric sulphate and deliver settled water to an aerator on the top of the middle one of three filter tanks from which it passes to the filters.

The filter plant receives raw water with a color of about 200 parts per million and with ferric sulphate coagulant and delivers filtered water to a Permutit installation for final feedwater treatment with a color of approximately 10 parts per million.

Both the coagulating tanks and the filter tanks were supplied by the Chicago Bridge & Iron Company.

Steam Generation

Coal handling equipment for the main boiler house was furnished by Robins Conveying Belt Company. This equipment includes a track hopper, an apron feeder of 100 tons per hour capacity, a belt conveyor, a reciprocating feeder, a belt conveyor equipped with a self-reversing and self-propelled tripper for discharging coal to the bunkers and a Merrick weightometer for recording the weight of coal passing over the conveyor, a circular storage bin

Fig. 38—Drive side of machine from dry end. Fig. 39—Paper machine oiling system equipment. Fig. 40—Platform scale in finishing room.

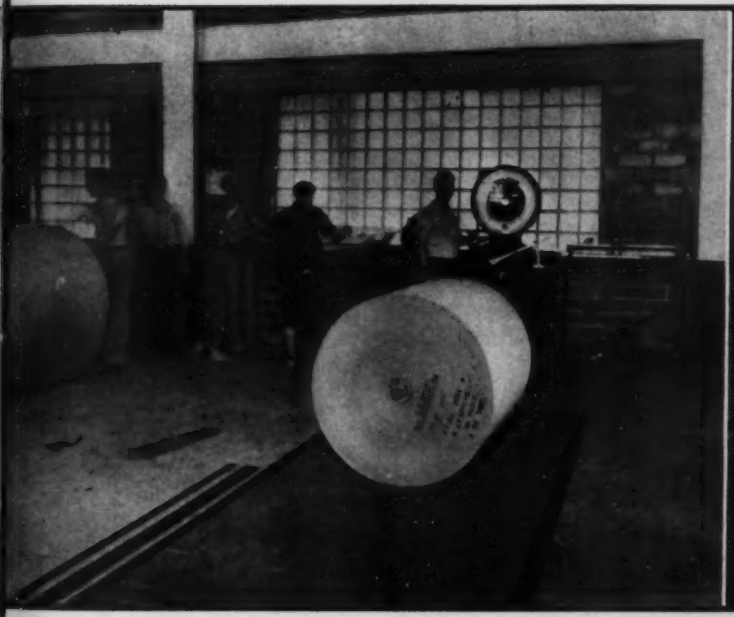


Fig. 41—Electric truck handling paper roll. Fig. 42—Coagulating and filtering tanks for boiler feedwater. Fig. 43—Coal storage.

for coal and other necessary appurtenances.

The major equipment of the main boiler house as well as the bark boiler house which immediately adjoins it includes an Elliott deaerating heater, two Riley boilers, a B & W boiler, and Smoot and Republic control equipment.

The Elliott deaerating heater has a capacity of 600,000 lb. per hour and delivers feedwater of a zero oxygen content.

The furnace volume of each of the Riley boilers is 12,390 cu. ft.; the boiler heating surface 11,490 sq. ft.; the water wall heating surface 6,500 sq. ft.; and the superheater heating surface 2,050 sq. ft.

Each of the boilers is built for an operating pressure of 602 lb. per sq. in. and is fed with pulverized fuel produced by a No. 5 Riley Atrita unit pulverizer or with fuel oil, if desired.

Each of the steam generating units is individually equipped with a B. F. Sturtevant forced draft fan and with a B. F. Sturtevant induced draft fan. The forced draft fan, for each boiler operating at 1150 r.p.m. and requiring 50 hp., has a delivering capacity on 80 deg. air of 77,500 CFM against 9.2 in. static pressure. The induced draft fan, for each boiler requiring 302 hp. and operating at 860 r.p.m., delivers 125,000 CFM against 9.4 in. static pressure when handling 330 deg. gas.

The B & W boiler unit, complete with loop-tube superheater, air heater, B & W forced-draft steam-mechanical-atomizing oil burners, has 7,293 sq. ft. of heating surface. It is designed for a working pressure of 600 lb. per sq. in. and a total steam temperature of 700 deg. Fahr. when operating at maximum capacity of 48,000 lb. of steam per hour with bark fuel.

An M. A. Hofft Company bark burning extension furnace of three compartments serves the boiler for the burning of bark and wood refuse which it receives from the wood preparing operations.

Boiler House Instrumentation

Automatic control of the two Riley boilers is obtained through the installation of a Smoot combustion control system. This system governs the fuel supply, the air and combustion gas flow through the furnace and the furnace draft. A regulator receiving its measured impulses from a master controller governs the pulverized coal supply by varying the speed of the feeder of each pulverizer by operating the feeder motor rheostat. Simultaneously, the vanes of the induced draft fan are moved to the proper position by a regulator actuated from the master controller to adjust the flow through the boiler in accord with the fuel-air ratio established at the master controller.

The furnace pressure is controlled by a regulator actuating the vanes of the forced draft fan on each boiler. This regulator, which receives its impulses from the pressure in the furnace, also is indirectly subject to the supervision of the master controller.

The master controller panel, set on the main operating floor of the boiler room together with the operating panels for power and bark-burning boilers, carries manometers that indicate master loading pressures. It carries also an adjustment for the fuel-air ratio of each boiler or of both together and provides for operation of both boilers at any steam output or of each unit at a different output.

Smoot feedwater level controllers, in which a mercury differential measuring element, actuated by water level changes, causes a regulator to operate a Smoot turbine-type valve in the feedwater supply line, make the operation of each boiler completely automatic.

Whenever it is desired, control can be changed instantly from automatic to manual, without interfering with operation in any way, by moving a simple lever on the master controller panel.

All information needed by the attendants when boilers are under either automatic or manual control, is indicated, recorded and, where necessary, integrated on two Republic panels.

Push button controls adjust high and low speeds of forced draft and induced draft fans and pulverizer feeders. Ammeters show operating status of pulverizers and fans. Boiler drum pressure is shown by an indicating gauge.

A 10-unit multi-point indicating instrument on each panel indicates furnace draft; suction in boiler behind superheater, at boiler exit, at air preheater exit, and at induced draft outlet; pressure of secondary air at pulverized coal burners; pressure of air entering heaters; differential draft across gas side of air heater and steam flow from boiler in thousands of pounds. Just below the 10-unit multi-point indicating instrument is a 6-pen strip chart recorder which records automatically steam flow from boiler, CO_2 at air preheater exit, steam temperature, and temperatures of air entering air heater and of gas entering and leaving it. An integrator totalizes steam flow from the boiler while boiler water level is recorded on a separate circular chart.

The bark burning boiler is not under full combustion control, since its operation depends to a large extent on the amount and character of the available fuel. A regulator, however, controls the inlet vanes of its induced draft fan in accordance with the draft in the furnace while a 9-unit multi-point indicator indicates furnace suction; suctions at boiler exit and air preheater exit; air pressures under three zones of bark burning stoker; pressure at forced draft fans discharge; and quantity of steam made by the boiler. Likewise, a 5-pen strip recorder provides a record of steam flow from boiler, total steam temperature, temperatures of air leaving air preheater and of gas entering and leaving it. On this panel, too, is a round type recorder, with accompanying integrator, showing total flow of steam from the recovery units. A feedwater level recorder, steam flow integrator for registering steam production of unit, gauge for boiler drum pressure, push button controls for forced and induced draft fans and ammeters showing their current consumption complete the panel.

In this control panel group is also a main steam and feedwater panel designed to supply necessary records of total steam output of the three groups of boilers and the corresponding input of feedwater. One 2-pen circular chart instrument on the panel records main header steam pressure and temperature; while another records pressure in the main feedwater header and

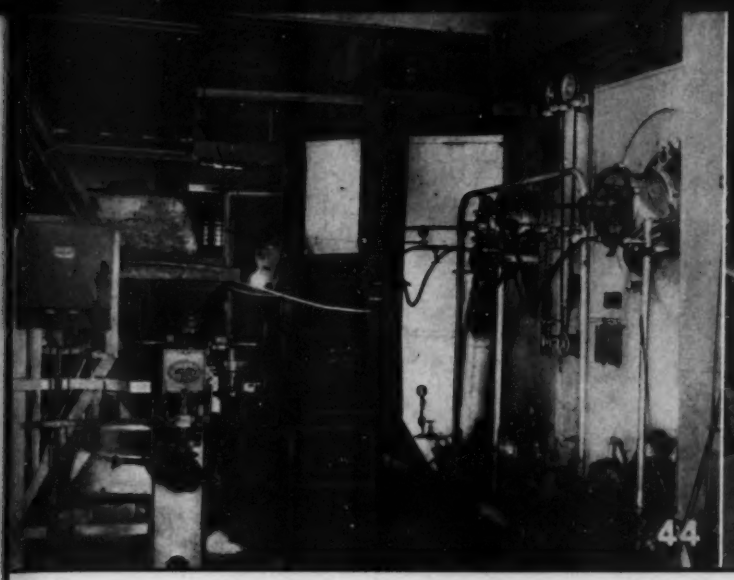
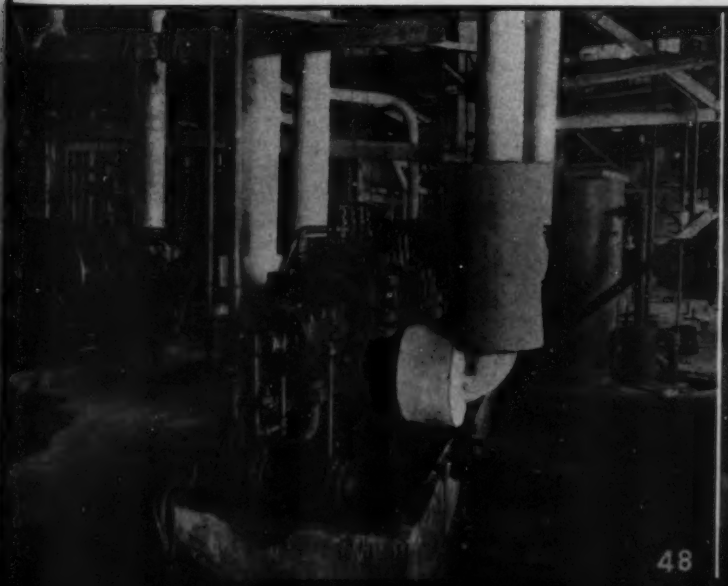
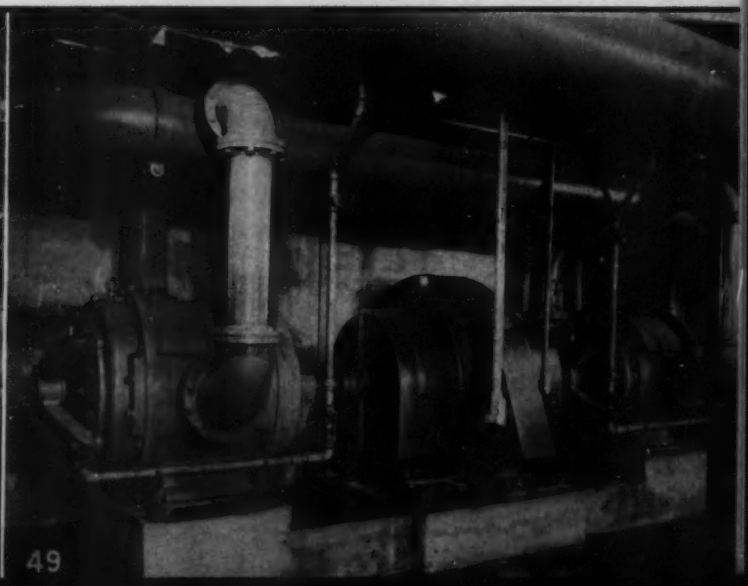


Fig. 44—Main boiler room. Fig. 45—Turbine room showing turbine generators and control panels. Fig. 46—Main switchboard.

Fig. 47—Fire pump installation. Fig. 48—Boiler feed pump. Fig. 49—Two vacuum pumps driven by single motor.





feedwater temperature at the feedwater heater outlet.

Turbine Generator Installation

The steam developed by the several boilers is delivered to two 7500 kw., 2300 volts, 3 phase, 60 cycle Westinghouse turbine generators or it may be by-passed to a 150 lb. header, desuperheated and sent to processes at 150 lb. and 35 lb. by means of cross connections and reducing valves between the low-pressure headers.

The turbine generators, like the bark burning boiler installation, adjoins the main boiler house. One of these units is non-condensing. The non-condensing unit is bled at 150 lb. and exhausted at 35 lb.; while the condensing unit is bled at 35 lb.

The 30 lb. steam is used in the paper machine dryer and for black liquor evaporation; the 150 lb. steam, for the digester.

Instrumentation for the two turbine generators includes two turbine instrument panels, one for each of them, and a desuperheater instrument panel. The panel for the non-condensing turbine carries: a 1-pen circular chart instrument recording steam flow to turbine throttle; a 3-pen instrument recording flow, pressure and temperature of 150 lb. extraction steam; a similar instrument for the 35 lb. exhaust steam; and a 2-pen instrument recording lubricating oil pressure and temperature. The condensing turbine panel carries the same number and type of recorders as the non-condensing unit, except that they are for 35 lb. extraction pressure and condenser vacuum, and, in addition, the panel carries a barometer.

Indicating watt-meters and electrical control switches also are mounted on both panels.

The desuperheater panel includes a 3-pen circular chart instrument for recording flow of 600 lb. steam to a 600-150 lb. reducing valve as well as pressure and temperature at desuperheater outlet; and two single pen instruments, one for recording steam flow from the desuperheater to the 150 lb. header, the other for recording steam flow at the 35 lb. reducing valve. Pressure gauges for the 150 lb. and 35 lb. steam headers, a desuperheater hand control valve and integrators for all these steam flows complete the panel.

Within the power house also is a steam and water distribution panel which carries sixteen single pen recorders and integrators. These instruments show the flows of steam to paper machine, digesters, evaporators, boiler feed pump header, and feedwater heater; and record flow of water to power boilers; flow of condensate returns; flow of makeup water to feedwater heaters and flow of raw water to water softener.

On three of these integrators, those registering flows to boiler, makeup to feedwater heater and total raw water to softeners, electrical contactors operate in such a way that as 1,000 gal. of water is registered, a proportioning device in the water softener installation injects a predetermined supply of treatment into the water.

Most of the steam and water distribution instruments are of the electrically operated, remote-reading type, and like those of the recovery boiler, bark burning boiler and Riley boilers, were furnished by Republic Flow Meters.

In fact, Republic instruments provide a total of 81 indicators, 77 records and 31 integrations of pressures, drafts, temperatures, and flows of steam, water, black liquor, flue gas and fuel oil in the boiler plants and turbine room.

Distribution of Electrical Energy

Electrical distribution equipment in the power house and in the switch house which adjoins it on the side opposite the main boiler house includes a Wolfe & Mann control panel and an installation of switchgear by Condit Electric Company.

All of the electrical energy, with the exception of that used to operate the pumps at the pumping station, is transmitted from the power house to each department at 2200 volts. It is used at that voltage for all motors with a capacity of 50 hp. or over; but is stepped down to 440 volts for all motors under 50 hp. The voltage on the pumping station line is 4,100 and about 3,000 ft. of this line is buried in the earth.

Lead covered cable, furnished by The Okonite Company, is used about the mill for the distribution of the 2,200 volts. Such of this cable as is used in the millyard has its lead sheath alloyed with 2 per cent tin to make it more resistant to wear and messengers are used to support it. Similar cable inside the plant but protected against damage with galvanized interlocked steel tape armor in accordance with code requirements is hung on the building.

Other wire and cable, including coarse bare wire, stranded wire, weatherproof wire, varnished cambric insulated braided power cable, varnished cambric lead power cable, Parkway and Duraseal cable, control cable, building wires, portable cable, welding cable, and portable cords was furnished by the Anaconda Wire & Cable Company. Junction boxes also were supplied by the same concern.

Large sizes of a mild steel conduit, supplied by the Clifton Conduit Company, likewise were used to carry lines which involved the making of many offsets and a number of wide radius bends. Other conduit, of a hot-dipped galvanized rigid steel type, was furnished by the Triangle Conduit & Cable Company, Inc.

Other interesting facts about the distribution of electrical energy in this mill include the use of General Electric cubicle type switchgear for the 2,200 volt motors, the use of General Electric Pyranol transformers for both power and lighting, and the use of No-Fuze breakers for 440 volt motors and lighting panels. In addition, only two wound rotor motors are being employed to drive equipment; field current of synchronous motors is controlled through tapped resistors rather than rheostats; and practically all of the motors start across the line.

Nearly all of the motors within the mill are Westinghouse; but a number of General Electric, Reliance Electric, Louis Allis Company, and Electric Machinery motors also are in evidence.

Other electrical equipment likewise was furnished by both the Allis-Chalmers Manufacturing Company and Cutler-Hammer, Inc.

Pumps, Piping and Valves

Approximately 200 pumps are installed in the mill for various service applications. These pumps include

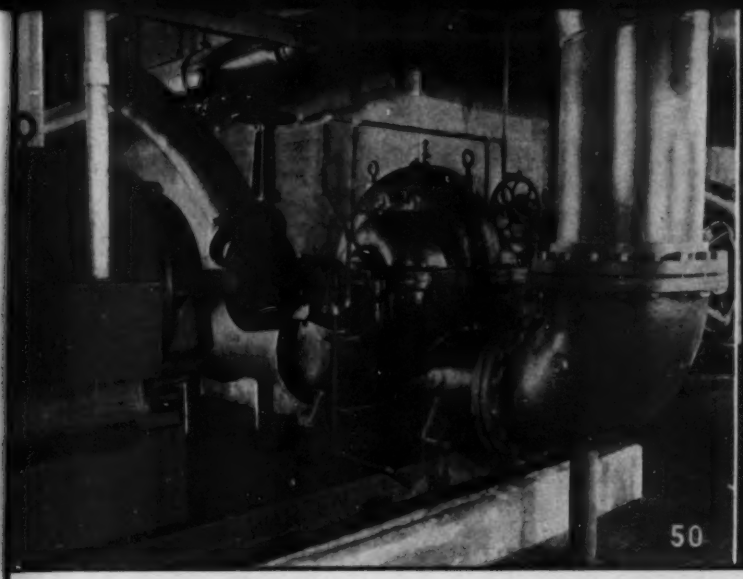


Fig. 50—One of the larger centrifugal pumps. Fig. 51—A stock pump installation.

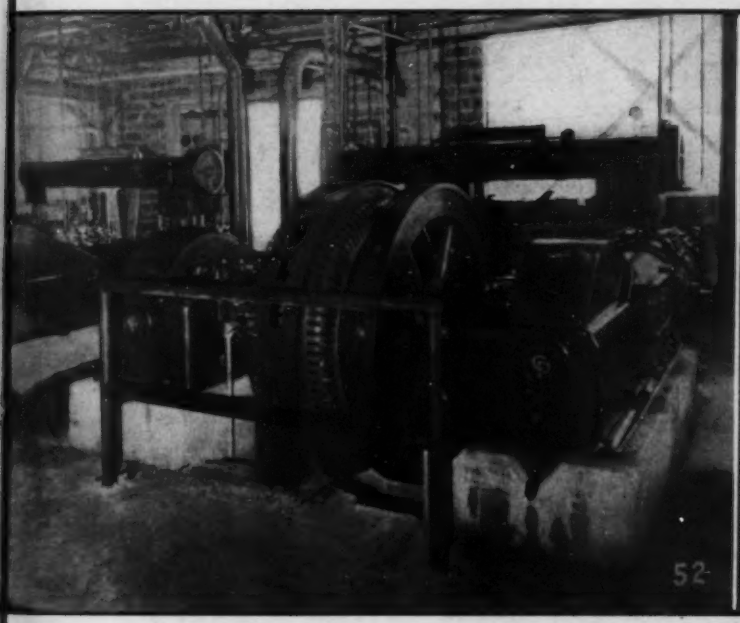


Fig. 52—One of two air compressors. Fig. 53—Mill ambulance.

units manufactured by the Duriron Company; Goulds Pumps, Inc.; The La Bour Company, Inc.; Morris Machine Works; Nash Engineering Company; and the Warren Steam Pump Company.

The Duriron installation is for the handling of alum solution; while applications for Goulds units are primarily for stock handling and miscellaneous service.

Of the Goulds installations, there are two 8-in. units, each handling 2,000 g.p.m. of 4 per cent stock against a 75 ft. head; two 8-in. units, each handling 1,600 g.p.m. of 4 per cent stock against a 100 ft. head; and two 8-in. units with an individual capacity of 1,500 g.p.m. that are handling 4 per cent stock against a head of 115 ft. In addition, there is a 6-in. unit of 1,000 g.p.m. capacity handling 3 per cent stock against a 35-ft. head; and a 4-in. unit handling 400 g.p.m. of 3½ per cent stock against 130-ft. head as well as several smaller pumps in miscellaneous service.

The La Bour pumps are installed in connection with the evaporator installation for the transfer of black liquor in backward flow through the system.

The circulating pumps on the sulphate digesters are Morris Machine Works units as are most of the pumps used in the preparation and handling of the cooking liquor. Some of the characteristics of these latter pumps are given in the accompanying tabulation.

Pumps for Liquor Preparation and Handling

Number	Size (Discharge in Inches)	Capacity (G. P. M.)	Motor Size (H. P.)
1	1½	150	..
4	1½	150	5
1	1½	150	7½
2	3	300	10
2	3	400	..
2	3	400	10
1	4	300	5
1	4	400	7½
2	6	500	10
3	6	600	30
1	6	600	50

Number	Size (Discharge in Inches)	Capacity (G. P. M.)	Motor Size (H. P.)
1	6	800	10
2	6	800	15
1	6	1000	50
1	8	1200	..

In addition, five vertical sump pumps of Morris Machine Works design are installed. One of these pumps is in the pan room; another in the digester building; a third unit in the evaporator building; a fourth unit in the caustic plant; and the fifth pump is for starch delivery in the machine room.

The paper machine is served by six Nash L-9 vacuum pumps which are grouped in pairs and each pair driven by a single General Electric synchronous motor which is located between them. One of these pumps normally will take care of the air from the flat boxes; three others, the couch; and each of the other two will serve a suction press.

Another L-9 unit serves the Impco lime sludge thickeners. An L-7 pump is used on the Impco thickeners; and an L-6 unit and a centrifugal serve another washer. Other Nash equipment also is used in connection with the water system.

A number of pumps of Warren Steam Pump design are used for stock handling as well as for various water service applications. Size of individual units, type of units, and number of each size and type is revealed in the following tabulation:

Number	Size (Discharge in Inches)	Type*
2	1½	single suction
1	1½	double suction
1	3	double suction
4	4	double suction
1	5	double suction
1	6	....
1	6	double suction
1	10	single suction
3	12	single suction
1	12	double suction
2	14	double suction
3	18	double suction

*All units are single stage

Other pumping installations include the use of Cameron pumps for boiler feed and a Worthington fire pump.

Two of the Cameron boiler feed pumps are individually driven through a Terry steam turbine. Each of the turbines is rated 600 hp. at 3500 r.p.m. and are designed for 550 lb. steam pressure, 700 deg. Fahr. total temperature, and 35 lb. back pressure.

Other of the boiler feed pumps are motor driven.

The bulk of the piping within the mill is steel; but other piping is employed for special applications. A considerable quantity of the steel piping which is used makes use of Tube-Turns and welded joints.

The piping system, for the most part, is equipped with valves supplied by either Chapman Valve Manufacturing Company; Darling Valve and Manufacturing Company; Reading-Pratt & Cady Division of American Chain & Cable Company, Inc.; or by Record Foundry and Machine Company. Service applications for Reading-Pratt & Cady valves include saturated steam, superheated steam, cold water, hot water and caustic liquor. These valves are of all iron construction and consist of globe, angle, gate, solid wedge, check and cock types.

Stock valve requirements are met through the use of several hundred Record Foundry & Machine Company gate valves. These valves, either equipped with a rising screw stem or rack operated, are in evidence wherever the flow of stock is to be controlled.

Machine Shop

The machine shop is located in the area between the machine room and the main boiler house. Its building size is 60 ft. by 120 ft. and its equipment includes a 14-in. Lodge & Shipley lathe, a 36-in. by 42-in. Putnam Machine Co. engine lathe, a 40-in. Brown & Sharpe milling machine, a 60-in. by 60-in. by 20-in. Gray planer, a 54-in. Bullard boring mill, a 6-ft. Niles radial drill, a 24-in. Cincinnati drill press, a 24-in. Gould & Eberhart sensitive drill, a Leland Gifford drill, a 200-ton Niles wheel press, a Hilles punch and shear, a Newton cold saw, a Nazel air hammer, and a number of Lincoln Electric Welding machines.

Miscellaneous Equipment

There are many items of miscellaneous equipment which collectively are to the equipment installation as a whole what the wire is to a paper machine.

Among these items is a 60-in. by 60-in. Shartle breaker beater which is installed on the floor of the machine room basement directly under the dryer section. Then, too, there are two Chicago Pneumatic Tool Company air compressors, each individually driven through a 175 h.p., 3 phase, 60 cycle, 2,200 volt, Electric Machinery Company synchronous motor. Each of the compressors has a displacement of 1050 c.f.m. at 275 r.p.m., and each operates against 100 lb. per sq. in. gauge discharge pressure. In addition, there are two Otis elevators, one having a capacity of 2,000 lb. at 100 ft. per min.; the other lifting 1,500 lb. at 20 ft. per min. The platform of the larger elevator is 5 ft. by 5 ft.; that of the smaller, 4 ft. by 6 ft. The larger elevator is in the digester building and travels a distance of 97 ft. 8 in.; while the smaller unit runs between the basement and first floor of one of the other buildings, a distance of 22 ft. Control for the larger elevator is double button with five wood hatchway gates included. A safety device is provided on the platform of the smaller unit.

Likewise, both General Refractories Company and Harbison-Walker Refractories Company supplied refractories. Some of these refractories are used in the smelter furnaces, smelter boilers and rotaries of the Murry-Waern units. The rotary lime kilns also are equipped with refractory linings.

Chain supplied for conveyor purposes includes 3,000 ft. of Jeffrey Hercules chain made of Perduro acid resisting alloy and 5,450 ft. of Rex Z-Metal Durobar chain with K21 riveted steel attachments.

All of the lighting fixtures throughout the mill are of Benjamin Electric design. There is wide use of vapor proof units in both the pulp mill and boiler house.

Induced draft on the lime kilns may be developed through the use of two Claridge fans, one for each kiln, and another Claridge fan is connected to the chipper hoods as an exhauster.

The material handling equipment includes two Whiting cranes. One of these cranes has a capacity of 20 tons and a span of 87 ft. This crane, which is located in the machine room and which is in position to travel the full length of the room,

is equipped with two 10-ton Tiger trolleys. The other crane is a 20-ton unit with a span of 47 ft. 4 in.

A 42 in. by 60 in. Gruendler bark shredder is being installed for the reduction of bark from the drums.

Laboratory

The laboratory, utilizing about 4,000 sq. ft. of floor space, includes a main laboratory, a pulp testing room, library, laboratory office, operating office, board sample storage room, chemical supply room, and a filing room for reports.

Among the major items of equipment in the laboratory are: Valley Irons Works beater, sheet mould, hydraulic press and steam dryer; Williams freeness tester; Scott tensile machine; M. I. T. folding tester; electrically operated Mullen tester; Gurley stiffness tester; Gurley densometer; Elmendorf tear tester; laboratory paper cutter for cutting samples containing exactly one square foot; and a laboratory brass roll calender of 100 lb. dead weight.

Most of the work of the laboratory is in the control of plant operation, the testing of fuel oil and chemical raw material analyses.

First Aid Department

About 1,000 sq. ft. of floor space is given over to a first aid department. This space is divided between a waiting room, examination room, private office, and rest room.

Major equipment and supplies of the department include an examination table, a hospital cot, a Lyon metal cabinet fully equipped with various metal splints for all kinds of fractures; a pulmotor; an electric sterilizer; arm and foot baths; dressing carrier; metal and canvas stretchers; crutches; a General Electric refrigerator with various serums, medications for burns, infections, and other injuries; necessary linen and blankets; electric heater; scales; several chairs and stools; and a filing cabinet for the record card of every employee.

A trained nurse is in attendance 24 hours a day in the department. Likewise, a mill doctor spends a number of hours each day and is available upon call at any other time.

The mill also has its own ambulance in order to be able to meet most expeditiously any emergency that might arise in the transporting of an injured worker to a hospital in Charleston.

Design and Construction Responsibility

All responsibility for the design of the mill rested with the engineering department of the company of which G. R. Wadleigh is chief engineer. Supervision of construction for the company was the responsibility of E. F. Libby, resident engineer on the job.

The general contractor responsible for the erection of the mill as a whole was the Morton C. Tuttle Co., Boston, Mass. Design of the water system, however, was the work of Malcolm C. Pirnie, consulting engineer, New York, N. Y., while the installation of the several boilers, turbine generators, and switchboard was the responsibility of the individual firm supplying the equipment. In addition, the Tidewater Construction Company, Norfolk, Va., drove the untreated pine and cypress piles; and the many tons of steel work was furnished and erected by the Virginia Bridge Company, Roanoke, Va., and Birmingham, Ala.

BENNETT SIZE MAKING PROCESS

BENNETT

TRADE MARK

INSTALLED

WEST VIRGINIA PULP & PAPER COMPANY HAS

PIEDMONT 1932.

Bennett Rosin-Wax Size has been used continually ever since for sizing entire production of S. C. and M. F. Book, Post Card, Lithograph, and Varnish Label.

COVINGTON 1933.

Bennett Rosin-Wax Size has been used continually ever since for sizing entire production of S. C. and M. F Book, Lithograph, Varnish Label, Bond, Writing, Kraft, and Container Board.

WILLIAMSBURG 1934.

Bennett Rosin-Wax Size has been used continually ever since for sizing entire production of S. C. and M. F. Book, Specialties, Magazine, Rotogravure, and Surface Sized Papers.

CHARLESTON 1937

BENNETT ROSIN-WAX SIZE WILL BE USED FOR SIZING THE ENTIRE PRODUCTION OF KRAFT TEST LINER BOARD.

EMULSION PROCESSES

BENNETT INCORPORATED

ORIGINATORS OF ROSIN-WAX SIZE

General Offices: Cambridge, Mass. ● Plants: Lawrence, Mass., Cincinnati, Ohio, Chambly, Que., Hyde, England

VERTISING PAGES REMOVED

◆ Canada to be Site of Four New Pulp Mills

Fort William, Sioux Lookout, Kenora and either Sault Ste. Marie or Michipicoten, Canada, will be the site of four new pulp mills to be erected by as many companies, according to a recent report. All mills will have a 200-ton daily capacity except the one at Sioux Lookout that will produce 100 tons daily.

Huron Forest Products Company in which President C. U. Bay, New York; Vice-President John G. Sutherland, Toronto; and George H. Mead of Chillicothe, Ohio, are interested, is interested in new developments in Ontario as are Marathon Paper Mills and the Pulp Wood Supply Company.

◆ Inspection Trips Scheduled For TAPPI Visitors

Inspection of a Southern pine timber stand and visits to the Union Bag and Paper Corporation's new mill and the Pulp and Paper Laboratory of Savannah are three trips that should prove valuable to TAPPI members and guests at the fall convention to be held October 18-20 in Savannah.

The woods trip is featured in the program of the TAPPI fall convention to enable those at the meeting to inspect typical stands of longleaf, slash and loblolly pines in the Coastal area of the Southern pine region. In the Union Bag mill the visitors will see one of the most modern post-depression sulphate mills; at the laboratory they will witness the demonstration of newsprint and sulphite from Southern pine.

◆ Economy Pumping Company Announces Change of Name

The Economy Pumping and Machinery Company has changed its name to Economy Pumps, Inc., in order to avoid confusion with concerns having somewhat similar names, it was announced recently.

The company intends to move its staff and plant to Hamilton, Ohio, shortly and upon application to do business in that state discovered there was a conflict of names which the Secretary of State ruled should be eliminated. The change of name does not affect personnel, assets or obligations of the company.

◆ THE TITANIUM PIGMENT CORPORATION has announced that its Paper Development Laboratory, formerly located at 105 York Street, Brooklyn, N. Y., has been moved to 99 Hudson Street, New York City.

◆ Society of American Foresters to Meet in Syracuse

Plans for the largest and most important annual meeting the Society of American Foresters ever held are now well under way, according to Henry E. Clepper, executive secretary. The meeting will be held on December 16, 17 and 18 in Syracuse, N. Y.

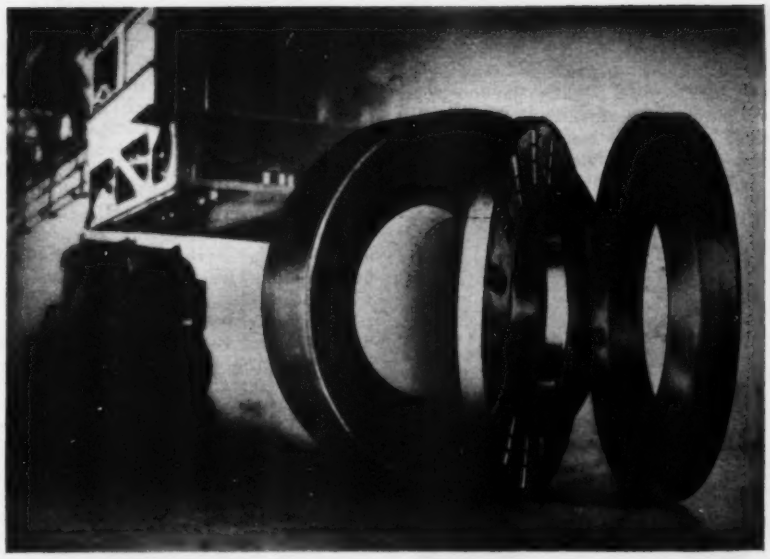
This will be the first time the society has met in Syracuse and a record breaking attendance is expected. It is estimated that almost 1,000 foresters will be registered at the meetings to be held at the Hotel Syracuse. H. H. Chapman, the retiring president, will make the opening address the morning of December 16. "What's New In Forestry" will be the topic for discussion.

◆ Paper Converting Company Ships Embosser to Norway

The Paper Converting Machine Company, Green Bay, Wis., has shipped a 50" Embosser for decorating Kraft paper to Moss, Norway, where it will be installed in a paper mill founded in 1806.

The machine was shipped with two complete sets of rolls, representing two distinct designs. It is anti-friction bearing equipped and the embossing unit carries a two-time paper roll. The rolls are so arranged to be quickly renewed and additional sets put into the machine.

◆ COLA G. PARKER, who has lately become affiliated with the Kimberly-Clark Corporation, Neenah, Wis., as assistant to the president, F. J. Sensenbrenner, has withdrawn from practice and membership in the law partnership of Wise, Whitney and Parker. The name of the New York law firm has been changed to Wise, Whitney and Canfield.



PROTECTED against dirt and moisture

A common materials handling bearing application was giving continuous trouble because of severe impact loads and overloads. It was necessary to work out a substitute bearing of much greater capacity, which would be wholly interchangeable, and protected in some degree from dirt and moisture. The lubricant, though adequate in quantity, was apt to be dirty.

ROLLWAY not only worked out the necessary bearing, a pure thrust bearing, using the principle of loads perpendicular to roller surface, but developed a line covering all standard application sizes. The result has been a very real saving to users throughout the country.

A ROLLWAY Analysis of your bearing problems aims at maximum performance, which only concentrated experience and study in a single field can give.

Note: This is one of the first occasions when any sort of seal was built integral with the bearing. Though fully exposed, not one of these bearings has ever failed through corrosion.

ROLLWAY BEARING CO., INC., SYRACUSE, N. Y. Factory Representatives in—Boston, Chicago, Cleveland, Detroit, Philadelphia, Pittsburgh, and Youngstown. Pacific Coast Representative: Precision Bearings, Inc., Los Angeles, San Francisco, Portland, and Seattle.

CYLINDRICAL ROLLER ROLLWAY BEARINGS

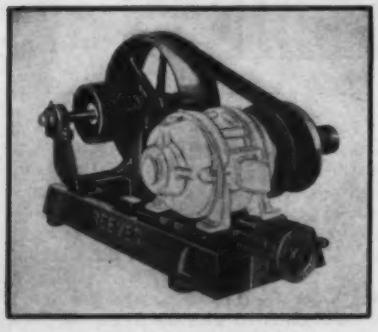
◆ Air-Operated Potentiometer Controller

The Taylor Instrument Companies, Rochester, N. Y., have announced a new air-operated potentiometer controller which utilizes a Fulscope control unit, the same as is used in the Fulscope temperature, pressure, rate of flow and liquid

level controllers, along with a Taylor Motosteel diaphragm valve and a Micromax recording and indicating potentiometer. Where precision valve action, or both precision valve action and compensation for changes in load may be necessary, the Fulscope control mechanism can be supplemented, respectively, with a Taylor Valv-Precisor or Dubl-Response control unit.

◆ Countershaft Type of Variable Speed Motor Pulley

Reeves Pulley Company, Columbus, Ind., has developed an improved design of its countershaft type of variable speed motor pulley. The countershaft pulley, in the new design, is mounted between two bearing housings rather than at the end of the shaft as was the case in the former design. Power take-off from the variable speed unit, designated as the Vari-Speed Motor



Pulley, may be from a straight face pulley, sprocket, pinion, multiple V-belt, sheave or other accepted drive. Desired speed changes are made through handwheel control. The Vari-Speed Motor Pulley, built in seven sizes, transmits from fractional to 7½ hp. and covers speed ratios of 3:1.

◆ Self-Aligning Bearings

Three distinct types of self-aligning ball bearings, designated as B, S, and L, are offered in a full range of sizes, according to a recent announcement, by the Fafnir Bearing Company, New Britain, Conn. In the "B" bearing the conventional outer ring is made with its outside surface spherical instead of cylindrical. A concave inner surface in the housing, corresponding to the convex outer surface of the ring, permits the bearing to swivel into true alignment with the shaft. The "S" type bearing retains the conventional cylindrical inner surface of the housing and provides an extra self-aligning ring with a concave inner surface. This extra ring surrounds the spherically ground outer bearing ring proper to form the alignment socket. The "L" type bearing gives self-alignment entirely from within the outer bearing ring, permitting housing to be both straight-bored and of minimum diameter. A double row of balls is used in all "L" type bearings, including single row widths.

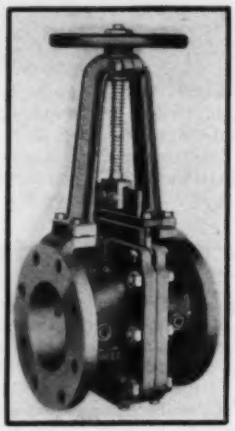
◆ Rubber to Metal Bonding Test

The bonding of rubber to metal so firmly that the metal actually turns inside out before the bond tears loose was revealed in a test conducted in the laboratories of the U. S. Rubber Products, Inc., 1790 Broadway, New York, N. Y. The test consisted of exerting a tremendous pull upon a rubber mounting (center

illustration) that was held firmly in a testing machine while a clamp gripped the two bolts located in its channel. In one instance (left illustration) the rubber bond still holds even after the channel has been pulled inside out. In another (right illustration), the bolt pulled out while the rubber continued to cling tenaciously to the metal plate.

◆ Paper Stock Valve

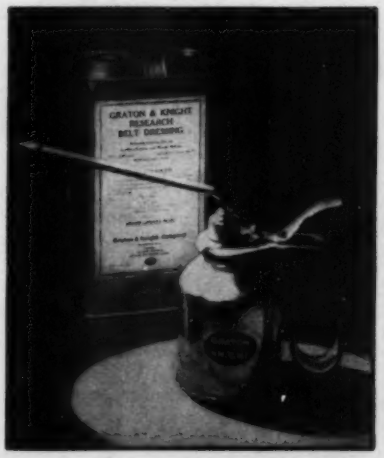
Crane Co., 836 South Michigan Ave., Chicago, Ill., has announced a new paper stock valve which utilizes a valve body that is made in halves and bolted together. This body, likewise, is equipped with six threaded and plugged openings, two on each side and two on the bottom, to permit connection with a water supply pipe for flushing the inside of valve and pipe line. The valve disc, a rectangular-shaped flat metal sheet with a cutting edge at the bottom, seats against a lead filler at the bottom of the body; while the part on the outlet side has notches around the bottom. When closing the valve, the downward movement of the disc forces any pulp which may have accumulated between the disc guide in the body to a cavity at the lower end of the guide recess, providing an outlet for the stock. At the same time, as the cutting edge of the disc passes the notches in



the port, it shears the stock from them. Any stock at the bottom of the disc, likewise, is sheared off. The valve, made in 4, 6, 8, 10, 12, 14 and 16-inch sizes and in outside screw, rising stem and quick opening types, is of flanged pattern with face to face dimensions the same as for the Crane standard iron body wedge gate valve.

◆ Belt Dressing Applicator

A trigger-action belt dressing applicator, designed so that two or three trigger squeezes apply enough dressing for the average belt, has been announced by



Graton & Knight, Worcester, Mass. This applicator can be used at some distance from moving units and permits application to be made evenly and in small quantities.

◆ Burst-Proof Steam Hose

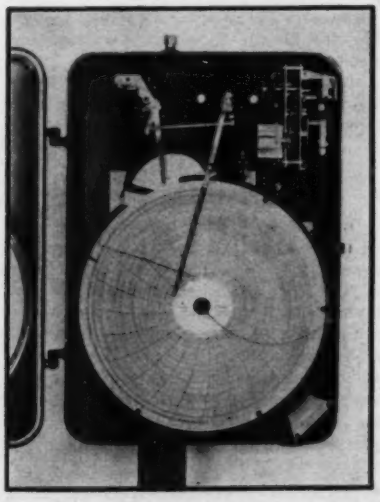
A steam hose, designated as burst-proof, has been introduced by The B. F. Goodrich Company, Akron, Ohio. A special heat resisting rubber compound is

used in the construction of this hose (as illustrated) for tube (A) and for insulating layers (C and E). High tensile steel wire is employed for the reinforcing layers (B and D), while layer (F) is a braid of strong asbestos cord and layer (G) is a heavy black rubber cover which is compounded heavily with a Goodrich

anti-oxidant, known as Agerite, to give it age resisting qualities. The hose is available in sizes ranging from ⅜ in. to 2½ in.; and is recommended by the manufacturer in all sizes for 200 pounds working pressure.

◆ Flow Meter Electric Integrator

An electric integrator, which totalizes flow once every 15 seconds, has been developed by The Bristol Company, Waterbury, Conn. Mechanical computation of the square root of the differential pressure across an orifice plate or venturi tube constriction in a pipe line at 15-second intervals is accomplished through the use of a flat disc cam designed to coincide with the flow law. The integrating mechanism consists essentially of a continuously running telechron motor which operates a counter through a train of gears. These gears are engaged and dis-



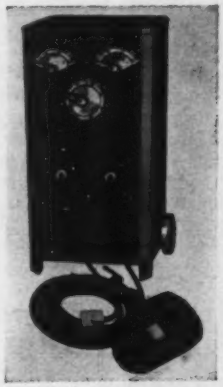
engaged by means of a mercury switch and magnet. The cam rider, which is connected through a link to the recorder pen arm, operates the mercury switch in one direction while on the cam and allows it to turn to its original position when off the cam. In the latter position the magnet is energized so that the gears are meshed and the integrator is totalizing the computations of flow. This type of integrator is used with Bristol's mechanical and electric flow meters which measure the flow of a gas or non-viscous liquid through a closed line.

◆ Valve for Severe Service

A bronze valve of union bonnet construction and employing a seat ring and disc of stainless steel with a minimum hardness of 500 Brinnell has been introduced by the Walworth Company, New York, N. Y. The valve is designed for general service on steam, air, oil, water and gas where conditions are exceptionally severe. It is available in globe and angle types and in sizes from ¼ in. to 2 in. Valve ratings are 350 lb. W. S. P. and 550 deg. Fahr.

◆ Portable Welder

An a. c. portable welder with separate voltage and amperage controls has just been put on the market by Miller Electric Manufacturing Co., Appleton, Wis. This



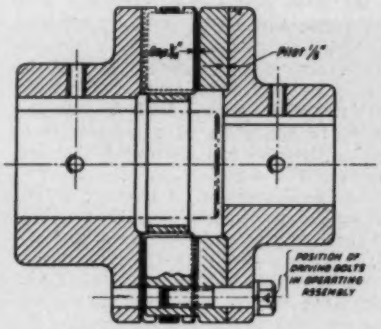
welder, known as "Dual Control," is built in three sizes with a current range from 10 amperes to maximum output. All three sizes have the same cabinet dimensions and vary in weight from 235 lb. to 350 lb.

◆ Metal Spray Gun Development

The Metals Coating Company of America, 495 North Third St., Philadelphia, Pa., has announced the development of a metal spray gun, designed as Majestic MetaLayeR, which, according to claims, will deposit approximately 100 per cent more metal over a given time with 1/3 less oxygen and acetylene consumption per weight of metal deposited in larger size wires. This gun can be lit and flames adjusted with or without the wire feeding. Final adjustment and control of oxygen, acetylene, and compressed air are made with one movement of the valve handle. The gun, depending upon the metal and size of wire, is operated with a compressed air pressure of 55 to 70 lb. per square inch and an oxygen and acetylene pressure of 8 to 15 lb.

◆ Flexible Coupling

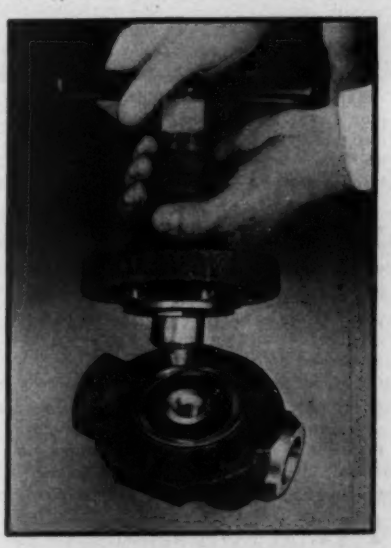
A flexible coupling, designated as L-R Type WQ, has been announced by the Lovejoy Flexible Coupling Co., 4947 West Lake St., Chicago, Ill. This coupling has one set of jaws which is in the form of a removable ring and which is held in place by a pilot, ⅛ in. in depth, and with alloy steel cap screws. The cap screws, 3, 5, 7 or 9, operate from the jaw body and drive the ring. Free floating cushions between the metal jaws carry the load, one-half of them, except on reversing loads, being idlers. These cushions, made of brake lining material, leather, or rubber duck fabric and retained by a steel band are re-



movable without tearing down the coupling. The gap between the cushions and the jaw body is ⅛ in. When the removable jaw ring is pulled over, a clearance of ⅛ in. develops which permits rotation of either half of the coupling. The coupling is made in standard sizes with bores from 1½ to 14 in. and with horsepower ratings from 2 to 2,000.

◆ Valve for High Pressure and High Temperature Service

The Hancock Valve Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn., has announced a new steel valve with a welded-in Stellite seat. The valve, known as the Hancock Duravalve and developed for high pressure and high temperature service (1500 lb. at 950 deg. Fahr.), is made on one basic size. It then



is tapped or bored for welding for ½, ¾ and 1-in. pipe. The manufacturer claims that this valve will take care of 90 per cent of the small valve requirements on any high pressure power plant job, and that it cuts repair part stocks and maintenance parts by two-thirds.

◆ W. H. Ryan Resigns From Wisconsin Traffic Association

President of the Wisconsin Paper and Pulp Manufacturers' Traffic Association since 1928, W. H. Ryan, who has recently resigned from Kimberly-Clark Corporation, has also resigned from the former organization.

Mr. Ryan first became identified with the Traffic Association on March 25, 1924, at which time he was elected a member of its executive committee. In 1927 he was elected vice-president of the association and in March, 1928, he was elevated to the office of president, since which time he has controlled the destinies of the organization.

At the September 28 meeting at the Union League Club, Chicago, the members of the executive committee presented Mr. Ryan with a beautiful cut glass set in token of their esteem and friendship. Mr. Ryan is now living at his summer home at Fish Creek, Wis., and during the winter months will return to his Appleton, Wis., home.

◆ E. B. Fritz Moves New York Office

The New York office of THE PAPER INDUSTRY, *Paper World* and *Paper and Pulp Mill Catalogue*, which is under the management of L. D. Schnabel, has been moved from 342 Madison Avenue to 9 Rockefeller Plaza. The new telephone number is Circle 7-3085.

◆ Kimberly-Clark to Move Cellucotton Division

As soon as buildings and additions now under construction by the Kimberly-Clark Corporation at its Lakeview mill, Neenah, Wis., are completed this fall, all of the Kotex and Kleenex conversion operations now conducted at the Badger Globe division, will be moved into the new plant.

The corporation will concentrate its cellucotton activities in the Lakeview plant and the space provided in the Badger-Globe plant by the change will be used for warehousing purposes and additional office departments.

◆ A RECENT PRESS REPORT stated that the Southern Kraft Corporation is building a rayon pulp mill at Springhill, La., in addition to the 650-ton kraft plant recently announced. It was further reported that the rayon plant will be completed in the early fall of 1938.

◆ A. J. NAVARRE, formerly general superintendent of the Minnesota and Ontario Paper Company, International Falls, Minn., is now general superintendent of the St. Joe Paper Company, Florida.

◆ TWO NEW VICE-PRESIDENTS, William C. Carter and Edward J. Burnell, were recently elected at the quarterly meeting of the board of directors of the Link-Belt Company, Chicago. Mr. Carter has been with Link-Belt since 1902, while Mr. Burnell has been associated with the company since 1913.

◆ C. A. Benson Has New Post with American Delthirna

The American Delthirna Corporation has announced the appointment of Clyde A. Benson as sales engineer. Mr. Benson is well qualified to direct the sales and installation of Delthirna Size units due to his experience as a chemist, his subsequent research work and his mill experience on sizing problems.

Mr. Benson was graduated from the Massachusetts Institute of Technology in 1922 receiving his B. B. in chemical engineering. Since his graduation Mr. Benson has been connected with the Brown Company at Berlin, N. H., the S. D. Warren Company at Cumberland Mills, Me., Oxford Paper Company at Rumford, Me., and the Oxford-Miami Paper Company at West Carrollton, Ohio.

◆ R. E. Hartman Goes to Port St. Joe

The appointment of R. E. Hartman as general manager of the new mill of the St. Joe Paper Company, Port St. Joe, Florida, has just been announced.

Mr. Hartman is very well known in the inndustry and for some time past has been president of the Mobile Paper Mills Co., Crichton, Alabama. Mr. Hartman has already entered upon his new duties at Port St. Joe.

◆ Stebbins Company Forms Pacific Coast Subsidiary

The Stebbins Engineering and Manufacturing Company has announced the formation of a wholly owned subsidiary, the Stebbins Engineering Corporation, Seattle, Wash., to better serve its customers.

The company has further announced that there will be no change in personnel, policy or service and that the west coast operations of Stebbins will be carried on as heretofore under the management of A. S. Quinn who will continue to maintain the corporation office at 1201 Textile Tower, Seattle.

◆ Rumor of Pulp Mill for Prince Rupert, B. C.

I. S. Steensland, executive vice-president of the Prince Rupert Pulp and Paper Mills, Ltd.; a firm incorporateed under the British Columbia Companies Act; has announced that this company may build a sulphite pulp mill at the northern B. C. port. This mill has no connection with the plant which was reported would be erected at Prince Rupert by a company headed by F. L. Buckley.

◆ THE SCOTT PAPER COMPANY, Chester, Pa., now has under construction a new paper machine which it is expected will be in production by the close of the year. The new machine, which is being built by the Beloit Iron Works, is especially designed for the production of ScotTissue and Waldorf tissues but can readily be adjusted to produce ScotTissue towels, Waldorf towels and ScotTowels for kitchen use.

◆ Clarence R. Falk

Colonel Clarence R. Falk, secretary and treasurer of the Falk Corporation, Milwaukee, Wis., passed away recently. Colonel Falk was nationally known in his business field; that of manufacturing.

He was born in Milwaukee and began his busines career in the savings department of the First Wisconsin National Bank. Later he became dramatic critic for one of the daily papers. He was identified with the Cloos Electrical Engineering Company and in 1901 became associated with the Falk Corporation where he worked his way up through various departments to become works manager. In 1914 he was made vice-president. He entered the World War as a Captain in the quartermaster's reserve corps at Jeffersonville, Ind., and remained in service until the end of the war when he became a Lieutenant-Colonel. Returning to the Falk Corporation he took up his duties and in 1923 was made secretary and treasurer, the position he held until the time of his death.

Colonel Falk served on numerous civic, philanthropic and educational boards and was a patron of music and a pioneer aviation enthusiast.

◆ Elmer G. Powers

Elmer G. Powers, sales manager of the George A. Whiting Paper Company, Menasha, Wis., was fatally injured in an automobile accident near Appleton, Wis., recently.

Mr. Powers, in company with John W. Hewitt, Jr., and Mrs. F. J. Sensenbrenner of Neenah, was returning to Appleton after a field trial with hunting dogs. The car failed to negotiate a turn and crashed into a telephone pole.

Mr. Powers had been with the Whiting Company since 1920 and had a wide acquaintance in the paper industry. He is survived by his widow and parents.

◆ Howard E. Beedy

Howard E. Beedy, vice-president and treasurer of the Oxford Paper Company, passed away suddenly Sept. 3 at his home in New York City. Mr. Beedy was forty-seven years of age and was head of operation activities of the company. He was a graduate of Yale University and served as captain and regimental adjutant during the World War. He is survived by his widow and a brother, former Congressman Carroll L. Beedy of Maine.

◆ OLIVER UNITED FILTERS, INC., has announced the appointment of E. Corning Faber to its sales engineering staff. Mr. Faber has had many years filtration experience and was formerly associated with Filtration Engineers, Inc.

◆ FORMER EXECUTIVE OF THE Consolidated Water Power and Paper Company, Wisconsin Rapids, Wis., George C. Schneider, has been named president of the Soo Pulp Products Company, a recently formed paper and pulp manufacturing company which has headquarters at Toronto.

The Paper Industry Safety Contest

July 1, 1937 to June 30, 1938

Two Months Cumulative Scores as of August 31, 1937

46 Mills Have Perfect Record

PERFECT SCORES

Division I—Paper and Pulp Mills

	PARTICIPANT	MILL	LOCATION
GROUP A	Consolidated Paper Corp., Ltd.	Wayagamack Div.	Three Rivers, P.Q., Can.
	Container Corp. of America	Philadelphia	Pennsylvania
	Bryant Paper Co.	Kalamazoo	Michigan
	A. P. W. Paper Co., Inc.	Albany	New York
	Rainier Pulp & Paper Co.	Shelton	Washington
GROUP B	Kimberly-Clark Corp.	Niagara	Wisconsin
	Paterson Parchment Paper Co.	Bristol	Pennsylvania
	Thilmany Pulp & Paper Co.	Upper Mill	Kaukauna, Wis.
	Pioneer-Division-Flintkote Co.	Los Angeles	California
	Thilmany Pulp & Paper Co.	Lower Mill	Kaukauna, Wis.
	Southern Kraft Corp.	Marinette	Wisconsin
GROUP C	The Crystal Tissue Co.	Middletown	Ohio
	Strathmore Paper Co.	Woronoco	Massachusetts
	Blandin Paper Co.	Grand Rapids	Minnesota
	Finch Pruyn & Co., Inc.	Glens Falls	New York
	Container Corp. of America	Carthage	Indiana
	Union Bag & Paper Corp.	Fenimore Paper Mill	Hudson Falls, N. Y.
	The Harriman Co.	Harriman	Tennessee
GROUP D	Container Corp. of America	Circleville	Ohio
	Lawrence Paper Co.	Lawrence	Kansas
	Crown Willamette Paper Co.	Lebanon	Oregon
	Bird & Son, Inc.	Phillipsdale	Rhode Island
	Union Bag & Paper Corp.	Allen Paper Mill	Hudson Falls, N. Y.
	Spaulding Fibre Co., Inc.	Milton	New Hampshire
	The Mead Corporation	Nashville	Tennessee
	United States Envelope Co.	Morgan Paper Co. Div.	Lititz, Pennsylvania
	The Flintkote Co.	Lockport	New York
	Ponds Extract Co.	Seymour	Connecticut
	Hollingsworth & Whitney Co.	Aroostook & Cobbossee Mills	Gardner, Maine
	Rogers Fibre Co., Inc.	Bar Mills	Maine
	Alton Box Board Co.	Carlyle	Illinois
	Spaulding Fibre Co., Inc.	Hayes Plant	North Rochester, N. H.
	International Paper Co.	Riley No. 23	Riley, Maine
	Division II		
	Union Bag & Paper Corp.	Specialty Bag Factory	Hudson Falls, N. Y.
	Bird & Son, Inc.	Norwood	Massachusetts
	National Container Corp.	Long Island City	New York
	Marathon Paper Mills Co.	Wausau	Wisconsin
	Union Bag & Paper Corp.	Grocers Bag Factory	Hudson Falls, N. Y.
	Bird & Son, Inc.	Chicago	Illinois
	The Barber Company, Inc.	Madison	Illinois
	Texas Corrugated Box Co., Inc.	Dallas	Texas
	Container Corp. of America	Natick	Massachusetts
	Bemis Bros. Bag Co.	East Pepperell	Massachusetts
	Bay West Paper Co.	Green Bay	Wisconsin
	Fisher Paper Box Co.	Minneapolis	Minnesota
	Bird & Son, Inc.	Shreveport	Louisiana

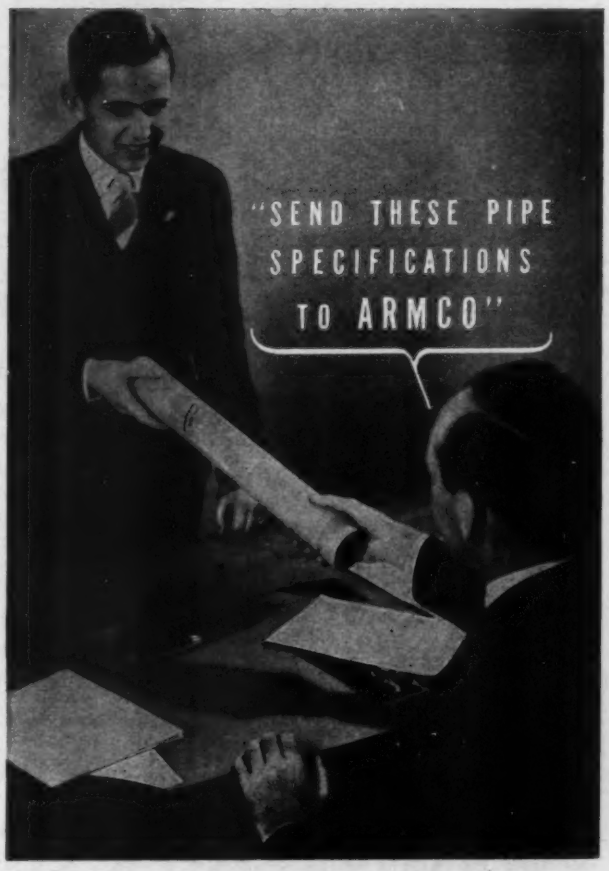
IMPERFECT SCORES

	Key Number	Rank	Disabling Injuries	Frequency Rate
GROUP A	P-108	6	1	1.946
	P- 1	7	2	3.128
	P- 69	8	1	3.136
	P- 22	9	1	4.576
	P-139	10	2	5.480
	P- 12	11	2	5.702
	P-121	12	2	6.013
	P- 18	13	3	6.165
	P-102	14	2	6.263
	P- 11	15	2	6.292
	P- 10	16	3	7.731
	P- 28	17	7	8.255
	P- 27	18	8	8.375
	P- 84	19	3	8.726
	P- 21	20	3	9.769
	P- 9	21	6	11.581
	P- 19	22	3	11.933
	P- 67	23	6	11.951
	P-136	24	4	12.913
	P- 73	25	7	13.084
	P- 2	26	4	15.275
	P- 58	27	4	17.339
	P- 3	28	4	18.358
	P- 62	29	8	19.607
	P- 23	30	6	22.025
	P-120	31	3	25.914
	P- 64	32	5	27.431
	P- 32	33	8	30.853
	P-140	34	10	33.189
	P-114	35	19	38.870
	P- 82	36	8	39.258
	P- 87	37	18	44.743
	P- 40	38	15	46.015
	P- 71	39	13	52.741
GROUP B	P- 60	7	1	5.009
	P- 89	8	1	5.765
	P- 4	9	1	6.071
	P-100	10	1	6.585
	P- 55	11	1	8.325
	P-122	12	2	11.126
	P-123	13	2	11.412
	P- 70	14	2	11.853
	P-124	15	2	11.933
	P- 16	16	2	12.046
	P- 15	17	2	12.158
	P- 97	18	2	12.479
	P-107	19	3	16.026
	P- 46	20	2	16.350
	P-119	21	3	20.775
	P- 25	22	4	20.982
	P- 26	23	5	25.421
	P- 45	24	4	27.933
	P-130	25	6	30.823
	P-137	26	5	32.705
	P-104	27	12	76.962

	Key Number	Rank	Disabling Injuries	Frequency Rate
GROUP C	P- 43	8	1	12.471
	P- 17	9	1	12.550
	P-113	10	1	12.828
	P- 47	11	1	12.982
	P- 48	12	1	14.728
	P- 88	13	2	17.462
	P- 61	14	2	17.981
	P-103	15	2	29.082
	P- 14	16	2	30.039
	P- 6	17	2	31.394
	P- 29	18	2	36.696
	P -41	19	6	53.646
	P- 94	20	4	56.478
	P-111	21	6	67.565
	P- 80	22	5	74.247
GROUP D	P-134	16	1	18.641
	P- 42	17	1	25.688
	P- 93	18	1	27.022
	P- 99	19	1	29.801
	P-106	20	2	47.604
	P- 81	21	2	47.664
	P- 7	22	3	50.733
	P- 98	23	2	53.446
	P- 65	24	1	57.978
	P- 63	25	3	61.238
	P-110	26	1	64.696
	P-138	27	4	80.562
	P-131	28	3	99.519
	Division II			
	R- 6	14	1	5.759
	R-23	15	1	5.862
	R-21	16	1	7.916
	R- 1	17	1	11.795
	R- 5	18	2	12.365
	R-10	19	1	13.054
	R-24	20	1	17.067
	R-13	21	1	23.043
	R- 9	22	1	23.463
	R-22	23	1	46.781
	R-26	24	6	80.154

No August Report—One month total only: Rogers Fibre Co., Inc., Bar Mills, Maine; International Paper Co., Riley No. 23, Riley, Maine; P-120; P-64; P-29; P-65; R-6; R-24.

END PIPE WORRIES THIS EASY WAY



A FEW LENGTHS or a hundred—it makes no difference. You simply mail your plans and specifications and we "tailor" Armco Spiral Welded Pipe to fit your job—including standard or special connections.

You'll appreciate this added convenience. And best of all, you are sure to like Armco pipe because it's so easy to handle and install . . . smooth inside for increased efficiency . . . and records show that it stands up well in paper mill service.

Put your pipe specifications in the mail today for diameters 6 to 36 inches; wall thicknesses 7/64 to ½-inch. Specify durable ARMCO Ingot Iron or steel—also your favorite protective coating, including galvanized after fabrication. The American Rolling Mill Company, Pipe Sales Division, 710 Curtis Street, Middletown, Ohio.

ARMCO

SPIRAL WELDED PIPE

◆ New Catalogues and Publications

Ajax Flexible Coupling Co., Westfield, N. Y.—A collection of data sheets covering many types of flexible couplings manufactured by this company have been bound and formed to make an attractive catalogue now being issued by this concern. This catalogue, 15 pages in length, presents the company's products by use of photographs, blueprints and specifications in addition to reading matter.

Allis-Chalmers Manufacturing Co., Milwaukee, Wis.—An attractive bulletin, No. 1542, has been issued recently by this company. It describes the application of Akon in connection with various water treating problems and contains some of the latest developments in the treatment of water for steam generation. The subject of water treatment is divided into several sections including: scale prevention, elimination of carry-over and the prevention of corrosion.

Bristol Co., Waterbury, Conn. — This company has recently issued a bulletin (No. 493) announcing a new Pyromaster Recording Potentiometer. This new instrument, offered in models for recording, indicating and controlling (both electric and air), is amply described by use of photographs, while reading matter points out the instrument's advantages. A more detailed bulletin (No. 489) may be had on request.

Brown Instrument Co., Philadelphia, Pa. —This company has just published a handsome new catalogue on Brown Pyrometers (Potentiometer Type). The new issue, 48 pages long and containing 73 illustrations, covers the complete line of instruments and explains the various uses of them. Diagrams, photographs and data charts are featured throughout. The book is bound with a shiny, semi-stiff cover of red and black, red and blue colors running throughout the edition (No. 1102).

Curtis Lighting Inc., Chicago, Ill.—Excellent photography is featured in a new publication (Handbook "J") by this firm. The book, 48 pages in length, explains the advantages of proper lighting in offices, schools, etc., and illustrates the mechanics involved in lighting certain places for the best results. A number of the firm's various lamp models are illustrated along with explanatory written material and diagrams.

DeLaval Steam Turbine Co., Trenton, N. J.—A rotary displacement pump intended primarily for fuel, lubricating and heavy crude oils, the DeLaval IMO pump, is described in a new catalogue put out by this firm. Photographs of the installed pumps and explanatory written material in this new publication (L-32) gives the reader a clear idea concerning the workings of the product thus described.

Dravo Corp., Pittsburgh, Pa.—An interesting new bulletin which explains the principles and installation of the Lee Direct Fired Unit Heater, has been issued recently by this company. This type heater, used in large buildings such as mills, factories, airship hangars, garages, etc., has a number of interesting features which are described in this publication. The operating units of the apparatus are made clear to the reader by use of photographs and diagrams.

Fairbanks, Morse and Co., Chicago, Ill.—The two stage built-together pump manufactured by this company is explained in detail in this firm's new publication (Bulletin 5592). The characteristics, features and application of the unit are made clear by use of tables, charts, photographs and written material.

Flexrock Co., Philadelphia, Pa.—A new broadside, issued by this company, explains the uses and applications of the surfacing material manufactured by the firm. Fifteen small photographs, incorporated in the broadside, show how the material is applied.

Geigy Company, Inc., New York, N. Y.—A number of color shades adaptable for the manufacture of wrapping tissue, kraft wrappers, construction papers and miscellaneous types of paper, are presented in this company's circular (286-D).

What other pipe could handle this job as well?

This trim installation of Taylor Spiral Pipe is simply one of the many applications for this sturdy, but light-walled pipe that no other type of pipe can handle as well or as economically.

More and more it is becoming apparent that Taylor Spiral is the paper mills' most versatile pipe. It is the easiest to install in the first place, the easiest to handle when conditions are changed, the most economical to buy and to maintain.

Whether it is a simple layout, or the most intricate layout requiring special fabrications, Taylor Forge has the answer to your piping requirements. Always remember that Taylor Spiral Pipe is about 50% lighter than ordinary wrought steel pipe and over 50% cheaper when installed.

TAYLOR FORGE & PIPE WORKS
General Offices and Works:
P. O. Box 485, Chicago, Ill.
New York Office: 50 Church Street
Pittsburgh Office: Gulf Bldg.

ASK FOR NEW CATALOG

TAYLOR Spiral PIPE

General Electric Co., Schenectady, N. Y. —A new circular (GEA-2434) has been published by this company illustrating and explaining the indoor potential transformers manufactured by the company. Diagrams and tables, in addition to photographs, illustrate the design and construction of the product.

General Printing Ink Corp., New York, N. Y.—For the convenience of the printer, the label maker and the carton and container manufacturer, this company has brought out three comprehensive booklets illustrating the inks on actual stocks used in their respective fields. Called "SUveneer" books (they are published by the Sigmund Ullman Company, a division of the parent company) these presentations are spiral bound and may be kept for a permanent reference.

Haveg Corp., Newark, Del.—A new data bulletin (A-1) on standard size pipe, fittings, valves and fume duct has recently been issued by this company. This bulletin should be of interest to anyone having to do with the handling of corrosive liquids or fumes. The bulletin is punched for loose-leaf filing.

Ideal Commutator Dresser Co., Sycamore, Ill.—A new catalogue which illustrates the various products put out by this firm has been circulated recently. Included in the catalogue are descriptions of the company's electric marker, wire stripper, slip ring resurfacers, wire skinner and wire straightener, turning tool and head, fuse pullers, circular saws and milling cutters, and washer punch.

Linde Air Products Co., New York, N. Y. —Two new folders, one which deals with steel hard-facing procedure and one which has to do with welded piping systems, have been released lately by this company. The first of these presents detailed instructions for applying the hard-facing material, Haynes-Stellite, to steel wearing surfaces. The second folder discusses the advantages of welded joints in installing piping systems. Photographs are used extensively in both publications.

James F. Lincoln Arc Welding Foundation, Cleveland, Ohio—This foundation, created late in 1936 for the purpose of stimulating scientific progress of the arc welding industry, has announced the first edition of its newspaper, *Arc Welding Foundation News.*

Link-Belt Co., Chicago, Ill.—This company has just issued a new folder (No. 1518-A) describing the Radiostat, an electronic temperature control for stoker installations in hotels, apartment and office buildings and other locations where the ordinary type of thermostatic control is not practical.

Magnus Chemical Co., Garwood, N. J.—A bulletin entitled *Manual of Paper Mill Cleaning Operations,* has recently been issued by this company. The book points out thirteen places where efficient slime removal saves time and money and discusses problems connected with the various phases of paper mill cleaning operations.

Oilgear Co., Milwaukee, Wis.—Fifty-four pages long and replete with photographs, blueprints, charts, tables and specifications, in addition to extensive reading matter, this new publication presents a most complete picture of the fluid power pumps and motors manufactured by this company. All of the firm's fluid power feeds and controls, hydraulic broaching machines, self-contained hydraulic presses, variable and constant displacement pumps and motors are presented and explained. The bulletin (No. 47000) is punched for loose-leaf filing.

Oxford Paper Co., New York, N. Y.—A new mailing piece, printed on the Oxford Mainefold, 100 lbs. basis, has to do with the subject, *Printing With A Purpose.* This bulletin, the eighth of a series, shows how paper helps to put speed into printing with a purpose.

Pittsburgh Tool-Knife and Manufacturing Co., Pittsburgh, Pa.—Sixteen pages long and complete with list prices of the saws complete, as well as of separate teeth and wedges, this firm's new catalogue has been issued recently. Featured in the bulletin is the Pittsburgh inserted tooth saw.

Quigley Co., New York, N. Y.—Several new bulletins have been released recently by this firm. Bulletin 281-B has to do with an anti-corrosive coating known as Triple A No. 20 Heavy-Duty Black; Bulletin 323-B15M explains the construction and use of the fire-brick made by the company and Bulletin No. 327-A25M illustrates the employment of the company's product, Insulag, a refractory lagging for temperatures up to 2200 degrees Fahr.

Revere Copper and Brass Inc., New York, N. Y.—An extremely interesting and attractive handbook on Herculoy, the company's new copper-silicon alloy, has been issued recently by the firm. Technical in nature, the book is well-planned and the reading matter is well-organized. The handbook explains the uses of this corrosion-resisting metal by first giving its properties and then illustrating the reasons for its employment. Over sixty pages long, bound in black and gold and filled with detailed drawings, fine photographs and explanatory charts, this publication would be a valuable addition to the industrial library of any concern.

Riegel Paper Corporation, New York, N. Y.—This company offers a colorful contribution in presenting its product, the Crystallon Cover, in a rainbow-tinted folder now being issued by the firm. Detailed information about this company's product may be had on request.

Roots-Connersville Blower Corp., Connersville, Ind.—In a new bulletin (40-B12) this company describes not only the general operating principles of the meters but also lists meters for smaller volumes than in previous bulletins. In addition to the standard low pressure meters for line pressures ranging up to 25 pounds, there are the high pressure types for maximum pressures of 125 pounds. The bulletin is entitled *Rotary Displacement Meters.*

M. B. Skinner Co., South Bend, Ind.—A handy little booklet which explains how to repair pipe leaks quickly, is the offering of this company. The applications and uses of the company's pipe line clamps, emergency clamps, pipe joint clamps, collar leak clamps, etc., are illustrated. A price list is included.

U. S. Department of Commerce, Washington, D. C.—A bulletin which describes the services of the National Bureau of Standards to the consumer has recently been issued by this governmental agency. The written material in the bulletin is divided into general categories of various products and shows the reader how products are tested and judged. Photographs are used extensively throughout. The bulletin is entitled *Services of the National Bureau of Standards to the Consumer* and is 27 pages long.

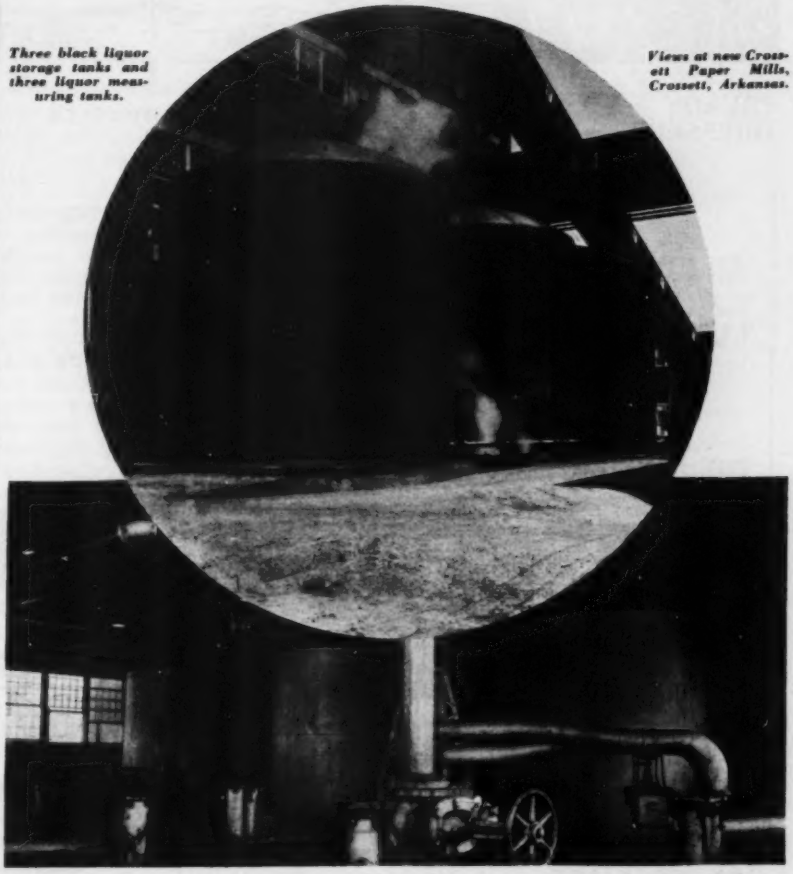
Yarnall-Waring Co., Philadelphia, Pa.—Water columns and gages for pressures up to 1500 pounds is the theme of the new bulletin (WG-1805) issued recently by this company. Cross-sectional drawings, photographs and diagrams aid the written material in presenting a detailed picture of the functions of the machinery. List prices are included in this publication.

BOOKS

Basic Industrial Markets in the U. S. Pulp and Paper Industry—This study is designed to offer industrial marketing executives a basic picture of the size and location of those parts of their market represented by the pulp and paper industry in the United States. Data are presented on a state and county basis and include twelve maps showing the distribution of production capacity for various kinds of paper and pulp. Copies of this booklet, identified as Market Research Series No. 14.4, 1937, Multilithed, are available from the U. S. Department of Commerce at a cost of ten cents.

Let's Look It Up—A considerable number of scientific technical books and American Chemical Society Monographs are listed in a folder now available from the Reinhold Publishing Corporation, 330 W. 42nd Street, New York, N. Y. An order blank is enclosed in the folder.

STEEL TANKS



Three black liquor storage tanks and three liquor measuring tanks.

Views at new Crossett Paper Mills, Crossett, Arkansas.

—built exactly like you want them!

GIVING you exactly what you want in tanks and other steel plate work is our foremost aim. Long experience in working with paper mill people has made us appreciative of the special problems and requirements of the industry. We specialize in elevated water tanks, flat-bottom storage tanks and stress-relieved pressure vessels. Quotations given gladly on any work you may be contemplating. Please address our nearest office.

CHICAGO BRIDGE & IRON COMPANY

Cleveland	2267 Rockefeller Bldg.	Boston	1562 Consolidated Gas Bldg.
Birmingham	1511 North Fiftieth St.	Los Angeles	1459 Wm. Fox Bldg.
Tulsa	1651 Hunt Bldg.	Chicago	2445 Old Colony Bldg.
Houston	2919 Main Street	New York	3350 Broadway Bldg.
Detroit	1566 Lafayette Bldg.	Dallas	1446 Liberty Bank Bldg.
Philadelphia	1653 Walnut Street Bldg.	San Francisco	1017 Rialto Bldg.

Plants at Birmingham, Chicago and Greenville, Pa.

"READY DRESSED" **MILL COGS**

LABOR SAVING—TIME SAVING

THE MOST ECONOMICAL FILLING THAT CAN BE PUT IN A MORTISE WHEEL

WE MAKE ANY STYLE OR SIZE WANTED

WRITE FOR INSTRUCTION SHEET "O" WHICH IS FREE

QUICK SERVICE ON ALL SIZES

THE N. P. BOWSHER CO., South Bend, Ind.

WIENER REFINERS

STOCK REGULATING VALVES

ENGINEERING AND DEVELOPING

WIENER REFINER ENGINEERING CO.

OSWEGO, NEW YORK

FOR SALE

1—300 KW G. E. modern MG set, 250 volts DC 2300/3/60, 35% leading P.F. complete. Especially desirable for P.F. correction.

1—2500 HP AC Mill motor type MT, G. E. 2300/3/60/240 rpm with Mesta reduction gear. Excellent condition.

4—700 HP G. E. Sl. Rg. motors type MT, 2300/3/60/393 rpm with contactor control, 2 or 3 bearing.

4—500 HP, same as above at 450 rpm.

Moorhead-Reitmeyer Co., Inc.

1—810 cu. ft. 100 lb. pressure Bury compressor belted to 130 HP G. E. syn. motor complete.

25—G. E. crane motors, types C01807-C02504-C02505, all 250 volt DC.

1—150 KW G. E. MG set, 250 volts DC, 2300/3/60 AC syn. motor with surbd.

1—150 KW Westinghouse, same as above.

Large stock of DC variable speed motors and slip-ring motors carried in stock.

Pittsburgh, Pa.

High Density BEATERS

Hundreds of highly successful installations in service.

A WORLD OF INTERESTS

THE MIDWEST-FULTON MACHINE COMPANY

DAYTON, OHIO, U. S. A.

FOR SALE—6-roll 47" wide and 3-roll 44" wide, Holyoke calenders. Belt driven with roll tension devices. Good condition. Address Box 265, THE PAPER INDUSTRY.

WANTED—Designing Draftsman for large eastern paper mill. Mechanical or Civil Engineering graduate, must be familiar with paper and pulp mill processes and equipment. Excellent opportunity for advancement of progressive young man. Address Box 266, THE PAPER INDUSTRY.

POSITION AVAILABLE in Development Group of large pulp and paper mill for qualified Mechanical Engineer. Applicant should have working knowledge of pulp and paper mill operations and experience in layout of paper mill equipment. Address Box 267, THE PAPER INDUSTRY.

MISCO "C"

THE CORROSION RESISTANT ALLOY

CAST • ROLLED • FABRICATED

for all equipment exposed to corrosion by sulphite acids

MICHIGAN STEEL CASTING CO., DETROIT, MICH.

PULP MILL MACH'Y ◆ FINISHING ROOM MACH'Y

◆ FRICTION CLUTCHES ◆

GUARANTEED REBUILT EQUIPMENT!

SLIPRING MTRS.

1—500 hp Al. Ch. 450 rpm
2—300 hp Wgse. 360 rpm
1—200 hp. G.E. 600 rpm
1—200 hp Burke 900 rpm
3—200 Al. Ch. 720 rpm

SPECIAL

1—1250 KVA Wgse. Synchronous Condenser 2300 3-60 3600 rpm

SYNCHRONOUS MTRS.

1—1000 hp Cr. Wh. 600 rpm
1—750 hp El. Mch. 514 rpm
1—315 hp G.E., 600 rpm
1—150 hp Burke 600 rpm
1—75 hp G.E. 1200 rpm

ENG. GEN. SETS

1—75 KVA Skinner Unaflow—G.E.
1—225 KVA & 1—150 KVA sim

MG SETS

2—750 KW Sync. (125V)
1—325 KW Sync. Compl.
Many smaller—all capac.

TURBO-GENERATORS

2—1250 KW Condens.
1—750 KW Condens.

AC GENERATORS

1—750 KVA Cr. Wh. 600 rpm
1—500 KW El. Mch. 514 rpm

CHICAGO ELECTRIC COMPANY

1323 West 22nd Street Chicago, Illinois *Write For Catalogue*

VEST POCKET POWER PLANTS

Small space occupied, any capacity, low over-all operating costs, high and extreme efficiencies, reliability, low initial investment.
Complete power plants to meet any operating conditions of Pulp and Paper mills or other Industrial service. Engineering and Construction.

Satisfactory Services Always Guaranteed.

FERGUSON ENGINEERS

Power Specialists

Monadnock Bldg., Chicago

DRY PAPER EVENLY

STICKLE AUTOMATIC STEAM CONTROLS
DRAINAGE SYSTEMS FOR DRYERS AND HEATING SYSTEMS
CONDENSATION ECONOMIZERS FOR HEATING AIR
DEAERATING FEED WATER HEATERS, REDUCING VALVES
STEAM TRAPS, OIL AND STEAM SEPARATORS

STICKLE STEAM SPECIALTIES COMPANY, 2217 VALLEY AVENUE, INDIANAPOLIS, IND.

◆ Johns-Manville Presents Story of Heat in Motion Picture

An important contribution towards the knowledge of heat control and heat conservation, was made when the first official showing of the Johns-Manville motion picture, "Heat and Its Control" took place recently in New York City, before an audience of 150 representatives of the industrial and technical press. At the same time J-M announced publication of the supplementary handbook, "Heat" which covers practically the same ground as the motion picture in greater detail.

"Heat and Its Control," filmed by Caravel Films, Inc., visualizes the story of heat from the time man worshipped the sun to present day methods of development and manufacture of heat conservation materials. Actual laboratory demonstrations, animated drawings and shadowgraphs are used in the picture to show the nature of heat and to illustrate heat transfer by radiation, convection and conduction. An interesting series of shadowgraphs actually permits one to see the air currents set up by heat in so-called dead air spaces as well as to see the convection currents set up by the flames, heated pipes and the like. Other animated drawings and laboratory demonstrations are used to explain the phenomenon of thermal conductivity and the reasons for the vast difference in the conductivity of various substances.

The book, "Heat," is divided into five chapters for easy reference and covers the history of heat from ancient times; the discovery of what heat is; the science of heat conservation; the modern materials available for conserving heat and lastly, illustrations of the specific use of these materials in individual industries. "Heat" contains 48 pages and will be given to each person attending a showing of "Heat and Its Control." They may be had on request from Johns-Manville, 22 East 40th Street, New York, N. Y. The motion picture will be shown at engineering society meetings and at special showings to other interested groups. Johns-Manville district organizations will handle all arrangements for such programs.

◆ U. S. Print Paper and Pulp Imports Tabulated

An accurate count of the amount of print paper and pulp it is necessary for consumers in the United States to import to supplement domestically produced supplies is contained in Volume 3, just issued by the United States Tariff Commission in a series of four volumes, entitled "Imports into the United States for Consumption, by Countries, for the Calendar Year 1936."

Work on this and three others in the current series of four volumes has been done as a project of the Works Progress Administration at Richmond, Va., employing 135 persons. Their publication follows that of a series of volumes giving comparative import statistics for the years 1931-1935, inclusive, tabulations which were also compiled by the Richmond project.

Following these publications, according to the Commission, in its Introduction to the Volume, "The demand for these statistics for work connected with the trade agreements program has been so great and the requests for similar information for 1936 have been so numerous that it is thought best to present the preliminary statistics for this later year in order that they may be available to the Government and the public in advance of their publication in final form by the Department of Commerce."

Imports in 1936 of the one item of "standard newsprint paper" are shown in Volume 3 to have amounted to 5,503,160,610 pounds, valued at $96,719,470. This was the largest single item of free list imports in 1936, which totalled $1,382,376,000. Free list imports were more than half in value in 1936 of all imports in the more than 4,500 separate classifications contained in the Tariff Act of 1930.

The value of the imports as given here and as fixed in general is explained by the Commission as being the foreign wholesale value converted into currency of the United States at the rate of exchange prevailing on the day the merchandise was shipped to the United States.

The great bulk of the standard newsprint imports is shown to have come from Canada, from which was imported 4,844,633,841 pounds valued at $86,498,969. From Finland came 246,060,427 pounds, valued at $3,506,289 and from Newfound-

THE EVIDENCE MULTIPLIES

There is an old saying—"Success begets success". It must be true.

During the first six months of 1937 more Bauer Double Disc Refiners were sold than in any like period of their fourteen years of paper mill service.

Over 125 are in service on ground wood screenings, kraft knotter and screen rejects, semi-chemical and semi-sulphite pulps, etc. They are "doing things" to paper and board stock where freeness, mullen, tensile and tear are important.

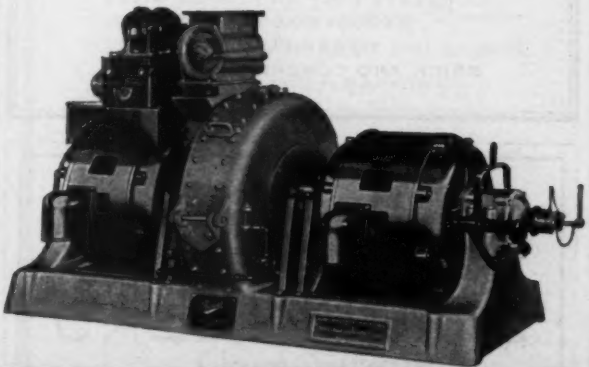
If you are interested in defibering of raw stock, removal of shiners, hard shive, broke spots, positively and completely. . . .

If you are interested in faster forming, faster draining, easier drying and stronger sheet. . . .

Have us explain the action of the Bauer Double Disc Machine more fully.

THE BAUER BROTHERS CO.

Box 509-I
Springfield, Ohio



BAUER BROS

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land and Labrador came 173,820,650 pounds, valued at $3,077,827. The other newsprint imports were from Sweden, Norway, Germany and Estonia, named in the order of value.

In addition to the newsprint imports, great quantities of chemical wood pulp and pulp wood, much of which was capable of conversion into newsprint and various other print papers, was imported duty free. A summary of the more important chemical wood pulp imports follows:

Classification	Tons Imported, 1936*	Value
Sulphite, unbleached, (including easy bleaching, news grade, strong, and Mitscherlich)	786,720	$26,778,644
Sulphite, bleached	512,168	25,824,769
Sulphate, unbleached	635,722	19,771,988
Sulphate, bleached	102,375	5,844,031
Soda pulp, bleached, unbleached	12,737	565,572

*Tons of 2,000 pounds, air-dry weight.

Principal quantities of the unbleached sulphite were imported from Sweden, with 425,753 tons, valued at $14,292,654, and from Finland, with 157,324 tons, valued $5,441,726. Other imports of this item came from Canada, Germany, Norway, Estonia, Lithuania, Czechoslovakia, Rumania, Latvia and Austria, with values in the order named.

The bulk of the bleached sulphite came from Canada, with 281,062 tons, valued at $15,295,458. From Norway came 70,950 tons, valued at $3,383,696, and from Sweden came 67,309 tons, valued at $3,011,668. Other imports came from Germany, Finland, Czechoslovakia, Rumania and Latvia.

From Sweden came 457,912 tons of the unbleached sulphate, valued at $14,005,839. Other imports were from Finland, Canada, Norway, and Poland and Danzig.

Imports of the bleached sulphate came principally from Canada and Sweden, with small amounts from Finland and Norway. All the bleached and unbleached soda pulp came from Canada.

All imports of pulpwoods were from Canada, from which came the following amounts in the principal classifications:

Classification	Cords Imported, 1936	Value
Spruce, rough	141,751	$1,102,199
Poplar, rough	44,252	286,156
Other woods, rough	14,700	73,943
Spruce, peeled	799,428	6,739,170
Poplar, peeled	107,650	638,560
Spruce, rossed	31,597	377,462

Rags for paper stock, also on the free list, were imported from 41 countries, the quantity being 275,892,835 pounds, valued at $4,673,041. Of this amount, nearly 60,000,000 pounds, valued at more than $1,000,000, were imported from France. Many other kinds of raw and waste materials were imported for paper making, though not for print paper.

The Volume contains a complete index of all 1936 imports of paper items.

*From statistics assembled by the Works Progress Administration Group.

◆ State Convention of Waltonians in Syracuse

The eleventh annual convention of the New York State Division of the Izaak Walton League will be held October 6 and 7 at the New York State College of Forestry at Syracuse University, according to an announcement by Max Frey, president of the division.

The headquarters of the meeting will be at the Syracuse Hotel but all business meetings will be held at the State College. Registration will begin at 9:00 o'clock A. M. in the faculty room of Bray Hall. At 10:00 A. M. invocation will be given by Rev. Arnold F. Keller of Utica. Dean Samuel N. Spring of the college will welcome the delegates to the convention.

The program will continue with reports of the various committees. Luncheon will be served 12:30 at Drumlins Country Club which will be followed by a field excursion to the forest experiment station in south Syracuse.

Conservation Commissioner Lithgow Osborne, Superintendent of State Forests William G. Howard, Congressman Clarence E. Hancock, toastmaster and Senator Francis McElroy will be the principal speakers at the banquet which will be held in the evening at the Syracuse Hotel.

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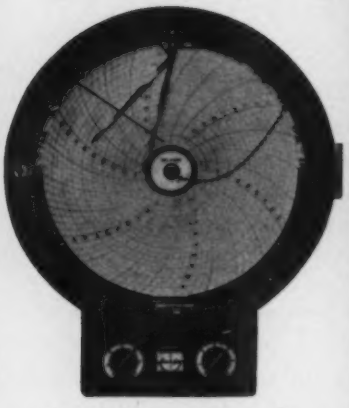

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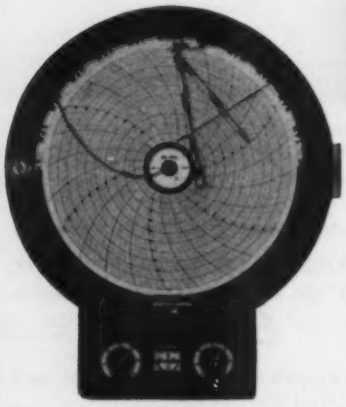

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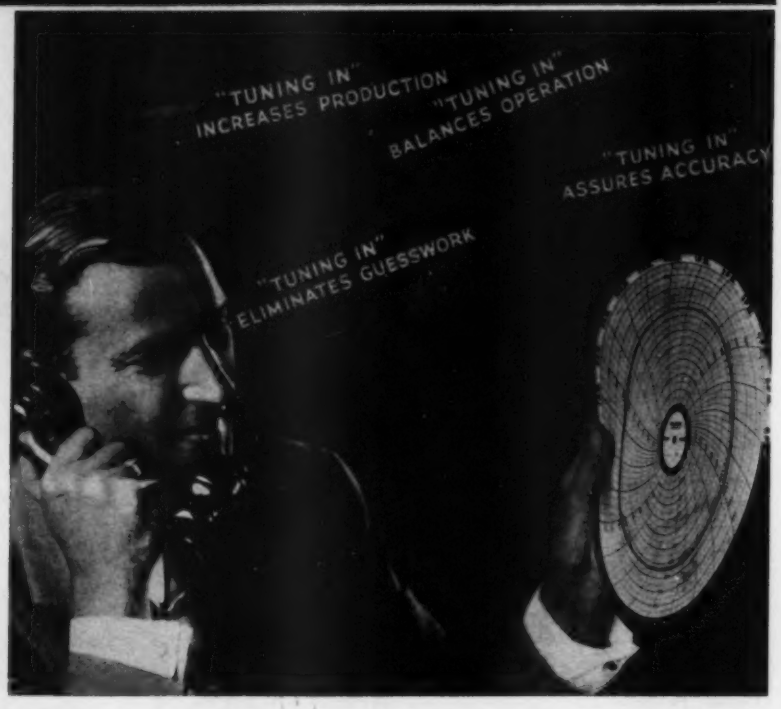

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This section turns the searchlight on power and its allied problems, showing big possibilities to save. Opportunities to improve conditions, methods, apparatus will be discovered. Worthwhile practices suggest new ideas and wider usages of equipment.

By W. S. JOULE

◆ Feed Water Heater Temperatures

Due to the intimate contact between the steam and the water in open heaters, it is possible, when there is plenty of steam, to raise the temperature of the water nearly to the temperature of the steam. A temperature of 210 deg. Fahr. is sometimes obtained. With closed heaters owing to the fact that the heat must be conducted through the walls of the tubes, there must be a temperature gradient of several degrees between the steam and the heated water which may be 15 deg. Fahr. or greater depending upon size of heater and condition of tubes.

Scale and oil do not interfere with heating in open heaters. On the other hand, they have the same effect in closed heaters as in boilers by acting as insulators to prevent transfer of heat. The deposit of scale and oil does not, however, introduce as great an element of danger here.

Heaters are sometimes installed so as to be wasteful. The storage capacity of open heaters is often small. The float actuated make-up valve keeps the water level at the highest point, and when a slug of drip water is returned it will overflow to the sewer unless some provision is made to take care of it.

◆ Shutting Down Turbines

Aside from an emergency, it is usually desirable to shut down a turbine when the total steam consumption of the plant would be reduced by taking one machine off the line. Remembering that continuity of service is paramount, it is not, however, advisable to reduce the number of turbines on the line below that which would permit of the complete loss of any one of them without a resulting break in the service.

When the unit has been disconnected from the station bus, the turbine throttle should be immediately closed. On large horizontal high-speed turbines the high and low-pressure shaft packings should be kept sealed until the machine has stopped rotating. Failure to do this will result in loss of vacuum and the rapid revolution of the turbine rotor in the relatively denser medium may develop enough heat to cause serious temperature stresses.

If the turbine has been in continuous operation without shutting down for a week or more it is a good plan to test out the emergency or over-speed governor at this time. A record of the speed at which this governor acts should be entered on the turbine log. The atmospheric relief valve should be operated also to make sure it is free and, if the turbine is equipped with a vacuum breaker, this can also be tested.

When the turbine has come to rest and its auxiliaries have been shut down, the turbine should be wiped clean and everything should be put in readiness for running when needed.

◆ Steam Should Be Clean

Due to the tremendous velocities of steam through the passages some erosion of nozzles and blades of turbines is to be expected. Rapid erosion may indicate that the parts are made of improper material but it is usually found that the steam has carried water or dirt. This condition should not be permitted to continue, since it is due to some fault in boilers or piping; a proper remedy should be applied at the source. Carrying over of large slugs of water with the steam may cause serious damage such as loosening or knocking out of buckets, sometimes with disastrous results. It is needless to say that the only way to prevent such troubles is to keep water out of the turbines. A well known operating engineer said recently: "These steam turbines will not run on hot water. You probably can realize what will happen to a set of blades traveling 40,000 ft. a minute with compressible steam operating on them at a high temperature, to get a sudden dash of a considerable quantity of comparatively cool, non-compressible water. It is very likely to take the blades off and to set up vibrations."

◆ Water Hammer in the Heating System

One of the objectionable features of certain types of steam systems is their liability to give forth loud crackling noises at times. In a well piped installation this should be impossible, but it occurs at times, seemingly in spite of everything. The cause is absorption of steam by cold water in the line, which of course should not be allowed to exist. Examine the piping to see that the grading is correct so that no pockets may be formed and all condensate may readily drain off.

Condensate and boiler feed pumps should be kept in the prime of condition; valves should seat properly, shafts should be carefully aligned, and the whole should be kept well lubricated. If direct acting piston pumps are employed, care should be taken to see that they are constantly on the job. Duplex pumps are not likely to stop, but pumps of the simplex type are liable to give trouble in this way, due to air binding, unless they are constantly watched.

Single pipe systems are particularly subject to this "water hammer" especially where the steam and condensate flow through the same main in opposite directions. If the piping is of insufficient capacity there will be an interference, the water will be picked up and driven to the end of the main with this characteristic noise. The difficulty may be eliminated by pitching the main away from the boiler and adding a wet return line. In some cases, the installation of a larger main will serve the purpose.

◆ Sparking—Its Causes and Remedies

Excessive sparking at the commutator is one of the most serious and perhaps the most persistent difficulty encountered in operating direct current electrical machinery, and due to the multitude of causes from which it may arise, is often difficult to eliminate. While a moderate amount of sparking is not objectionable, the detrimental effects are cumulative and in time may lead to serious trouble.

If sparking is allowed to continue in a machine, the effects will be made manifest in a burning and gradual roughening of the commutator, as well as pronounced local heating. Roughening of the commutator surface in this manner, of course, only serves to increase the violence of the sparking until finally it will so damage the machine as to make it necessary to shut down.

As stated above, causes of sparking are numerous and it is often due to a combination of conditions, or to conditions external to the machine itself. The most common conditions to which sparking is due, are fairly well understood, and in many cases sparking is only the result of negligence on the part of the attendants. Among the more common conditions conducive to sparking may be enumerated the following: (1) Overload; (2) Sudden changes in load; (3) Incorrect position of brushes, i.e., not set in exact neutral plane; (4) Unequal spacing of brushes; (5) Brushes not fitted exactly to the commutator; (6) Improper kind of brushes used; (7) Rough or pitted commutator; (8) Loose commutator bars; (9) High mica; (10) Insufficient brush pressure; (11) Oil or dust on the commutator; (12) Weak magnetic field; (13) Vibration of machine or ground; (14) Broken circuit or ground in the armature.

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PAPERMAKING PATENTS

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Compiled by James Atkins, Registered Patent Attorney

2,083,929—Process of Making a Beater Furnish. Earl P. Stevenson, Newton, and Howard J. Billings, South Acton, Mass., assignors, by mesne assignments, to The Richardson Company, Lockland, Ohio, a corporation of Ohio. No Drawing. Application February 20, 1933, Serial No. 657,670. 11 Claims. (Cl. 92—21). The process of manufacturing a papermaking furnish containing heat-reactive resins, which consists in mixing dry fibre with cresylic acid, formaldehyde, and an alkaline catalyst in the presence of water, and heating the resulting mixture to form a synthetic resin which, while remaining heat fusible, is insoluble in the reacting medium and non-tacky, the resulting fibre-resin mixture being characterized by the property of readily assimilating water and the reduction thereby to a watery pulp such as is used in paper-making.

2,083,969—Means for Forming Laminated Tubes From Web Material. Charles T. Walter, Chicago, Ill., assignor to Industrial Patents Corporation, Chicago, Ill., a corporation of Delaware. Application June 5, 1935, Serial No. 25,176. 2 Claims. (Cl. 93—82). An apparatus for forming tubular casings from web material comprising means for supporting a first web roll, means offset relative to the supporting means for supporting a second web roll so that one of the longitudinal edges of the web of the first roll will project beyond the corresponding longitudinal edge of the web of the second roll and the other longitudinal edge of the web of the second roll will project beyond the corresponding longitudinal edge of the web of the first roll, means for simultaneously feeding the webs of the several rolls, means for applying an adhesive to one entire surface of the web of the first roll, means for bonding the webs of the several rolls, means for applying an adhesive near the longitudinal edge of the web of the second roll adjacent the projecting edge of the web of the first roll and means for forming the resultant laminated web in the form of a tube with the longitudinal edges of each of the webs of the several rolls in over-lapping relationship to provide a double lapped seam.

2,084,278—Apparatus for and Method of Deckling Paper. Courtlandt B. Griffin, Longmeadow, Mass., assignor to Carew Manufacturing Company, South Hadley Falls, Mass., a corporation of Massachusetts. Application March 25, 1936, Serial No. 70,832. 8 Claims. (Cl. 92—68). The method of deckling the edges of sheets of paper which consists in, moistening the edges of a stack of sheets of paper along one face of the stack, and then directing a stream of fluid under pressure against said edges to remove parts thereof. The method of deckling the edges of normally relatively pliable sheets of paper to simulate hand-made deckle-edge paper which consists in, clamping together a plurality of sheets of paper in stack formation adjacent a face of the stack so that the body of the sheets adjacent said face are pressed tightly together leaving unclamped edges of the sheets movable relative to one another, and directing fluid under pressure from one nozzle against said edges to weaken the same and directing fluid under pressure from another nozzle against said weakened edges to remove parts thereof to provide irregular edges to the sheets.

2,084,318—Paper Feeding Mechanism. Francisco Campos, Paris, France. Application November 1, 1934, Serial No. 751,102. In Great Britain November 1, 1933. 5 Claims. (Cl. 197—128.) A paper feeding device comprising in combination, means for feeding a duplex sheet of record paper into a printing mechanism in a direction opposite to that of normal feeding, means for separating said duplex sheet to receive a duplicating medium, said means comprising a dividing element positioned adjacent an ink ribbon to cause the upper and longer fold of said duplex sheet to pass above said dividing element, and above said ink ribbon while the lower and shorter fold passes below, and means for feeding said sheet into printing position in one direction and out of printing position in the opposite direction.

2,084,358—Paper Manufacture. Harold Robert Rafton, Andover, Mass., assignor to Raffold Process Corporation, a corporation of Massachusetts. No Drawing. Application May 7, 1934, Serial No. 724,453. In Canada April 16, 1934. 22 Claims. (Cl. 91—68.) The step in a method of manufacturing paper filled with alkaline filler comprising distributing in a fibrous web containing alkaline filler substantially water insoluble organic liquid by means of a vehicle comprising a solvent in which said liquid is soluble.

2,084,490—Drier Felt. James E. Hooper, Ruxton, Md., assignor to William E. Hooper and Sons Company, Woodberry, Md., a corporation of Maryland. Application January 16, 1937, Serial No. 120,958. 6 Claims. (Cl. 24—33.) A dryer felt or apron having a joint comprising two integral end portions of the material composing the felt attached to which end portions are detachable means for joining the ends of the drier felt to close said joint, an integrally woven portion of the felt material on each side of said joint and adjacent each of said ends being folded upon itself and fastening means securing said folds to said end portions the bends of the folds on each side of the joint being in closely abutted relation substantially in the supporting surface of the felt closing the supporting surface of the felt when the joint is closed by the said detachable means.

2,084,741—Continuous Automatic Layboy. Richard P. Price, Erie, Pa., assignor to Hammermill Paper Company, Erie, Pa., a corporation of Pennsylvania. Application September 15, 1933, Serial No. 689,552. 16 Claims. (Cl. 271—76.) In a machine for stacking sheet material, means to feed the sheets in a continuous stream, means to support the sheets in a stack, means to intercept the sheets as fed, at a plane above the second named means, means carrying said intercepting means, means for causing said carrying means to bring said intercepting means into intercepting position, means brought into action by the movement of said carrying means to intercepting position to cause the supporting means to discharge the stack of sheets therefrom, and subsequently operative automatic means to cause the intercepting means to deposit the sheets thereon upon the supporting means.

2,085,128—Paper Dryness Control. Stephen A. Staege, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania. Application May 26, 1934, Serial No. 727,748. 6 Claims. (Cl. 34—48.) In a system of control for a drier, in combination, a plurality of drying elements, a valve for controlling the rate of admission of the drying medium to the drier elements, a motor for operating said valve, an electric discharge device connected in circuit relation with the motor and adapted to directly energize said motor, a control grid for said electric discharge device, a timing circuit for preventing the deenergization of the electric discharge device prior to the lapse of a definite interval of time after its energization, and paper dryness indicating means for controlling the grid of the electric discharge device as a function of the dryness of the paper.

2,085,144—Paper Feeder. Myron B. Bushnell, Los Angeles, Calif. Application March 25, 1936, Serial No. 70,824. 20 Claims. (Cl. 271—29.) A paper feeder for under-feeding sheets from a stack of sheet paper comprising means to separate the lowermost sheet from the stack adjacent one edge, a moving device to

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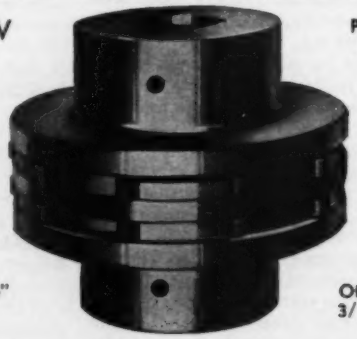

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engage said edge and move the separated edge in a general direction toward the remote edge of the paper, and an outfeeding means acting first on the said remote edge to remove the separated lower-most sheet of the stack.

2,085,675—Safety Paper and Method of Making Same. Francis L. Simons, Needham, Mass., assignor to George La Monte & Son, Nutley, N. J., a corporation of New Jersey. No Drawing. Application February 4, 1935, Serial No. 4,872. 8 Claims. (Cl. 91—67.95.) A safety paper having incorporated therein a mono-nitrogen substituted naphthylamine.

2,085,758—Stuff Treatment Apparatus. Charles P. Tolman, Kew Gardens, N. Y., assingor, by mesne assignments, to The Noble & Wood Machine Co., Hoosick Falls, N. Y., a corporation of New York. Original application March 28, 1934. Serial No. 717,717. Divided and this application January 12, 1937. Serial No. 120,314. 18 Claims. (Cl. 92—26.) In stuff treatment apparatus, the combination of a casing including a rotor chamber having end openings and a stator compartment arranged contiguous to a portion of said rotor chamber and presenting an inner opening between said chamber and said compartment, a rotor mounted in the rotor chamber and with its peripheral surface extending across and closing said inner opening and with its end surface free running and extending across a portion of said end opening, a stator mounted in said stator compartment, and means for retaining said stator in adjustable material treating relation to the rotor.

2,086,126—Method of Making Strip Gum Papers. John Stephen Gilchrist, Worcester, Mass., assignor to McLaurin-Jones Co., Brookfield, Mass., a corporation of Massachusetts. Application June 16, 1934, Serial No. 730,941. 2 Claims. (Cl. 91—68.) That improvement in processes of coating paper which consists in gumming substantially the entire area of one surface of a web of paper, drying the coating so applied, and thereafter applying spaced apart strips of non-adhesive waterproof material to the gum coating.

2,086,903—Grease Repellant Paper. Carleton Ellis, Montclair, N. J., assignor to Ellis-Foster Company, a corporation of New Jersey. No Drawing. Application March 14, 1928, Serial No. 261,708. Renewed March 26, 1937. 24 Claims. (Cl. 91—70.) A covering suitable for greasy articles, consisting of a paper coated or impregnated with a polybasic organic acid-polyhydric alcohol resin containing a higher fatty acid in chemical combination, the resin being of a character and present in an amount sufficient to give substantial grease repellant properties to the paper.

2,087,097—Manufacture of Pulp Rovings. John C. Sherman, Attleboro, Mass. Application March 4, 1936. Serial No. 66,985. 14 Claims. (Cl. 92—39.) Means for individually rubbing into rod-like form a plurality of spaced parallel pulp-ribbons said means comprising in combination the paper-making screen whereon said ribbons lie, spaced mandrels, a moving belt of resilient material mounted on said mandrels and maintained in frictional engagement with said ribbons, and a reciprocating engine which imparts to one only of said mandrels and to portions of said belt an oscillatory motion in the plane of the ribbons and at right angles to their line of forward motion whereby to progressively diminish the amplitude of oscillation of the belt over a predetermined length thereof.

2,087,559—Stuff Treatment Apparatus. Charles P. Tolman, Kew Gardens, N. Y., assignor, by mesne assignments, to The Noble & Wood Machine Co., Hoosick Falls, N. Y., a corporation of New York. Original application March 28, 1934. Serial No. 717,717. Divided and this application January 12, 1937. Serial No. 120,313. 3 Claims. (Cl. 92—26.) 1. In stuff treatment apparatus, the combination of a rotor, a feed chamber opening upon a segment of the peripheral surface of the rotor, and a stator mounted to form a stuff treatment zone with said peripheral surface and having a tapered nose extending into the feed chamber arranged to pass over-sized material, trash, or the like, from obstrucing position at the inlet end of said zone, and a nozzle for directing a jet against said material to facilitate its movement through said port.

2,087,560—Stuff Treatment Apparatus. Charles P. Tolman, Kew Gardens, N. Y., assignor, by mesne assignments, to The Noble & Wood Machine Co., Hoosick Falls, N. Y., a corporation of New York. Original application March 28, 1934, Serial No. 717,717. Divided and this application January 12, 1937, Serial No. 120,312. 1 Claim. (Cl. 92—26.) In stuff treatment apparatus, the combination of a rotor having transverse peripheral grooves alternating with lands to form an irregular peripheral contour, each of said grooves having its maximum depth near its trailing edge with a diminishing depth gradient toward its leading edge to produce in effect a succession of substantially stream line land and groove contours around the rotor periphery.

2,087,561 — Material Treating Apparatus. Charles P. Tolman, Kew Gardens, N. Y., assignor, by mesne assignments, to The Noble & Wood Machine Co., Hoosick Falls, N. Y., a corporation of New York. Application April 14, 1931, Serial No. 529,963. Renewed March 1, 1937. 22 Claims. (Cl. 83—14.) In material treating apparatus, the combination of a casing having walls adapted and arranged to form a rotor chamber and a plurality of separate stator compartments, a rotor mounted in the rotor chamber and a stator mounted in each of the stator compartments in operative relation to the rotor and adapted to form with said rotor a plurality of independent operable treatment zones, means for feeding material to the inlet end of each zone, and means for discharging material from the outlet end of each zone.

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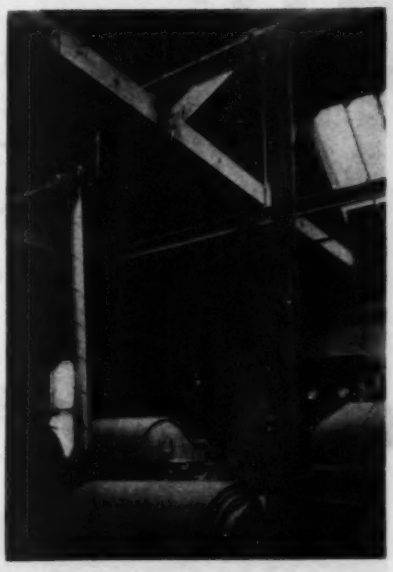

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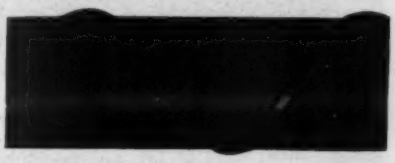

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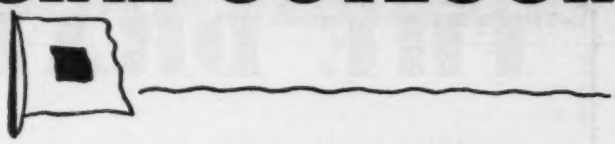
The COMMERCIAL OUTLOOK



New York, October 1, 1937.

A DECIDED change in atmosphere has occurred in the paper market. In fact, the change has been so drastic that, from a contrasting standpoint, it seems almost incredible. Only a comparatively short time ago consumers, converters and jobbers, looking forward to a brisk fall and early winter season, bought paper and board freely, not only for early delivery but also committed themselves a good ways ahead against anticipated broader requirements.

The attitude of buyers now is distinctly altered. There is a pronounced hesitancy on the part of consumers and distributors of paper to buy, other than to fill absolutely definite needs. The slowing down of general business, the declining trend in security values as well as in nearly all commodities, the failure of the customary fall stimulation of business to develop and other deterrent circumstances have driven buyers of paper almost completely out of the market. Demand is reported on all sides at a bare minimum, insofar as concerns current call for supplies.

Paper and board mills are not closing down; far from it. Nevertheless they are not nearly so busy as they expected to be at this time. Moreover, it is a fact most of the activity among mills is against contracts and back orders, that is business which manufacturers booked sometime ago. The hesitant attitude of buyers is somewhat difficult to understand. Overlooking signs above the surface of the business situation, generally speaking, there are indications plainly visible of a steady and sizable movement of merchandise. Retail distribution of almost everything the public buys and uses is showing a constant gain, all statistics relating to retail business recording accumulating increases. It is therefore hard to fathom why manufacturing and wholesaling have slumped to such a marked degree. Opinion within trade circles is that the prevailing condition is temporary only, and that during the next few weeks the apprehensions of buyers will disappear and markets will open up in a manner usually witnessed at this time of the year, to gradually expand and make up the loss in volume experienced thus far during this fall season.

The newspaper advertising index registered a gain for August of 4.6 per cent over the similar month of last year, and 1.3 per cent over July, according to Printers' Ink. The monthly index of magazine advertising for August increased 16.9 per cent over the corresponding 1936 month, but, corrected for seasonal variations, decreased 1.5 per cent under July.

Reports emanating from Canadian sources say that some shading of the $50 per ton price for newsprint paper announced by the International Paper Company and some other mills for the first six months of 1938 is in prospect. The reports say that the Great Northern Paper Company, whose announcement regarding 1938 prices is awaited, is expected to make known its price after a meeting of directors early in October, and that current indications are the advance in prices for all of 1938 will not be more than $5 per ton over the price of $42.50 which now prevails, making the probable figure for 1938, $47.50 per ton. United States publishers have been adding to stocks, and their supply of newsprint at the end of August amounted to 59 days, against 54 days at the end of July and 41 days at the end of June.

With Canadian production continuing to reach new high levels, North American output of newsprint in August rose 15.2 per cent over the same period a year ago. United States and Newfoundland mills also produced more newsprint in August than in the same month last year, and the cumulative totals for the year to date for the three countries also are running ahead of the corresponding month of 1936, according to figures reported by the News Print Service Bureau. Canadian output of 318,713 tons in August was 48,660 tons, or 18 per cent, greater than the 270,053 tons produced in August, 1936. United States production amounted to 80,311 tons, against 73,673 tons last year, and Newfoundland output was 30,519 tons, compared with 29,301 tons a year ago. United States and Canadian production totaled 399,024 tons, against 343,726 tons in August of last year.

For the first eight months of the current year, Canadian newsprint output aggregated 2,416,025 tons, contrasted with 2,033,943 tons in the similar period last year, an increase of 382,082 tons. United States production in the same time was 629,314 tons, against 607,173 tons, a gain of 22,141 tons. Newfoundland production for the eight months amounted to 238,063 tons, compared with 213,156 tons a year ago, an increase of 24,907 tons. This made a total North American output of 3,283,402 tons in eight months, against 2,854,272 tons last year, a rise of 429,130 tons, or 15 per cent. Canadian shipments in August were 313,435 tons, and United States shipments 75,724 tons. Stocks on hand at Canadian mills at the end of August were 85,256 tons, and at United States mills 17,676 tons, a combined total of 102,932 tons, compared with 87,258 tons on the same date a year ago.

Production of paperboard in the United States in July amounted to 344,080 tons, contrasted with 363,390 tons in the month preceding and 299,033 tons in the same 1936 month, making a total for the first seven months of this year of 2,702,234 tons, against 2,000,715 tons in the corresponding period of 1936, and 1,829,852 tons in the first seven months of 1935, according to the monthly summary of the U. S. Census Bureau. Board mills produced at an average of 85.7 per cent of their rated capacity during the first seven months of the current year, compared with 69.1 per cent in 1936 and 65.1 per cent in 1935. New orders received by manufacturers for board in July called for a total of 326,334 tons, against 315,787 tons in June this year and 304,747 tons in July last year. Unfilled orders held by mills at the end of July were for 90,391 tons, contrasted with 100,785 tons a month previously and 101,557 tons a year ago.

Shipments of prepared roofing from producing mills in the United States in July last totaled 2,152,482 squares, against 2,280,366 squares in the month preceding and 2,504,205 squares in July last year. The July shipments brought the aggregate for the first seven months of this year up to 17,676,658 squares, compared with 16,951,776 squares in the same period of 1936, and 14,220,655 squares in 1935.

◆ ◆

◆ Leipzig Fair Concludes Successful Session

The Leipzig (Germany) Fair has just concluded its 1978th session with a marked increase in attendance and exhibitors. The generally greater activity in world trade is reflected by the attendance of over 150,000 exhibitors and buyers from seventy-four countries. More than 6,000 buyers from foreign countries, including the United States, visited the fair as compared with 3,700 foreign buyers last fall. A general increase in the demand of both raw materials and finished products was indicated in world markets.

◆ THE HANCOCK VALVE DIVISION of Manning, Maxwell and Moore, Inc., Bridgeport, Conn., has announced the addition of Charles Velie and Raymond Heath to its corps of field missionary men.

◆ Purchasing Agents Assn. to Hold Exposition

The Ninth Annual Products Exposition of the Purchasing Agents Association of Chicago, will be held at the Hotel Sherman, Chicago, on November 17 and 18.

At the exposition there will be displays of the latest products, equipment and methods for the benefit of superintendents, engineers, foremen and production men as well as regular industrial buyers.

The program includes a luncheon meeting on Wednesday, November 17, at which time there will be speakers on purchasing problems, and the annual banquet on Thursday, November 18.

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A SURE WAY TO REMOVE SLIME

THERE is no need to worry any longer about overcoming slime troubles. Or of preventing heavy slime deposits from dropping on screen wires and causing spots and other waste.

Thanks to Oakite Slime Remover, you now can loosen and carry away *all* the slime in the average system easily and at low cost. Even the toughest deposits in beaters, piping, chests and boxes yield quickly to energetic, fast-working, thorough Oakite cleaning action.

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Domestic RAW MATERIALS

◆ Papermaking Rags

Along with most other commodities, raw materials for paper manufacture have in a majority of cases pursued a downward trend under quiet market conditions recently, the principal exception being wood pulp. Papermaking rags are in a much slower market position. Demand has simmered off to where it is well under normal for this period of the year. Ordinarily at this time the trade looks for paper manufacturers to increase their buying to an appreciable extent in preparation for the customary fall and winter improvement in production and distribution of paper, and the fact that the tendency in recent weeks has been in the opposite course is, to say the least, puzzling to rag dealers and importers.

The explanation seems to be that most paper manufacturers have accumulated inventories of rags, and other raw materials, of a volume not alone enabling them to hold off buying at present but, with circumstances in their own markets not too favorable, prompting them to reduce their stocks rather than add to them. Demand for most grades of rags has figuratively slowed down to a walk. There is, of course, some little spotty purchasing, but the aggregate quantities of rags moving into consuming channels are scarcely large enough to wage influence on the market. Moreover, as is so often the case when demand subsides, the trend in rag prices is altogether in favor of buyers.

Roofing rags have eased fairly sharply in the East after showing a rise a month or so ago. Prices are off to where No. 1 domestic roofing stock is offered at 1.60 cents a pound f.o.b. eastern shipping points and No. 2 domestic at 1.30 cents, and probably at slightly under these figures in certain instances. Roofing paper mills are engaging in very little buying. They report having sizable stocks on hand, and seem more concerned with working down some of these holdings than in increasing them, notwithstanding approach of winter and the danger of inclement weather delaying shipments. Foreign roofing stock is quoted at 2.15 cents upwards for linsey garments and 1.75 cents to higher for dark colored cottons ex dock American Atlantic ports, and importers assert they can hardly buy abroad at low enough costs to be able to sell at these prices profitably. In fact, the contention within the rag trade is that roofing rags are fairly strong from a supply standpoint, but apparently the comparatively bullish supply position is more than offset by the lack of worthwhile demand from consuming mills.

New cotton cuttings are in limited call also, and quoted rates tend lower. No. 1 white shirt cuttings are reported available in the East at 8.50 cents per pound f.o.b. dealers' points, new unbleached muslins at 8.25 to 8.50 cents, fancy shirt cuttings at 3.50 cents, light silesias at 7 cents, soft black silesias at 4.50 cents, new blue overall cuttings at 7.50 cents, light flannelettes at 7 cents, and washables at 2.75 cents. New linen cuttings hold to quotable levels of 12 cents a pound for white and 11 cents for grey at shipping points.

Old No. 1 white cottons are selling at 3.75 to 4 cents per pound, mostly for export, domestic paper mills purchasing few of these rags. Old blue cottons are in little demand and are obtainable at 2.25 cents a pound at shipping points for twos and blues and 2 cents for repacked thirds and blues.

◆ Old Paper

The waste paper market continues quiet. There is little other than routine demand, and board and other consuming mills are absorbing supplies in such reserved tonnage that prices are gradually drifting downward on most grades. Dealers express confidence demand will feel the customary fall stimulation and the market will register an upturn between now and early December, yet admit there is no visible sign of this on the horizon as yet. Prices of the low or bulky classes of old paper exhibit relatively greater weakness than the high grades. Old No. 1 mixed paper has declined in the East to 32½ cents per hundred pounds f. o. b. shipping points, folded newspapers to 42½ cents and old corrugated boxes to 45 cents per hundred pounds. Even at these comparatively low price levels there is hardly sufficient buying to support the market and keep values from sagging.

Book stock has eased to a cent per pound for No. 1 heavy flat books and magazines at shipping points in the East, and old kraft paper has moved substantially lower in price to 1.15-1.25 cents a pound at dealers' points for No. 1 quality kraft. Shavings are about stationary in price on quotable levels of 2.60 cents up to 3 cents, according to quality, at shipping points for No. 1 hard white, and 2.20 to 2.40 cents for No. 1 soft white with one-cut soft white priced at 2.70-2.75 cents. Hard white envelope cuttings of No. 1 grade are 3.10 to 3.15 cents a pound, white ledgers 1.80 to 1.85 cents, colored ledgers 1.60 to 1.65 cents, and white news cuttings 1.40 to 1.45 cents.

◆ Rope and Bagging

Further decline has occurred in quotations of paper mills on old rope. While very little demand exists currently, those papermakers who are buying are bidding only 4 cents a pound f. o. b. shipping points for No. 1 domestic old manila rope, and in frequent cases below this level, ex dock basis, for imported old rope, representing a recession of at least $5 per ton from previous market prices. On the other hand, there seems a little better call for old bagging though it is stated the improvement, such as it is, has been brought about by purchasing of consumers other than paper manufacturers. No. 1 scrap burlap for papermaking is quoted at 1.90 cents upwards per pound at shipping points for domestic, and generally at higher levels for the imported material. There has been a buying flurry in old gunny bagging and sales have been reported up around 2.50 cents a pound ex dock American Atlantic ports for foreign gunny. Roofing bagging is slow-moving and nominally 1.15 cents per pound for domestic at shipping points and 1.30-1.35 cents for foreign ex dock Atlantic ports.

◆ Pulpwood

While open-market demand for pulpwood has subsided to a noticeable degree, quotations are maintained and reports say there is little or no pressure to sell as virtually all the supply coming in to sight is under contract and therefore moving forward to consumers.

◆ Mechanical Pulp

Domestic producers of groundwood are naming steady prices, on a basis of $37.50 per short ton delivered at consuming points in northern United States, but demand in the market currently is slow at best. The truth of the matter appears to be that consumers have their needs covered by contract commitments and stocks on hand, and are not disposed to augment their supplies at present. Moreover, water conditions have been favorable, and consumers in numerous cases have been enabled to grind all the pulp they have required, thus removing a good many prospective buyers from the outside market.

◆ Chemical Pulp

Prices of domestic sulphite, bleached and unbleached, announced to contract customers for the fourth quarter of 1937 are advanced to $5 per ton above third quarter levels. Prime bleached sulphite is 3.50 to 3.70 cents, according to quality, ex dock American Atlantic seaboard for October-December delivery, and unbleached sulphite 2.85 to 2.95 cents a pound, also ex dock basis. Domestic bleached soda pulp is up $2 a ton to 3.25 cents a pound delivered consuming mills for fourth quarter. Offerings of southern kraft pulp at 2.50 cents a pound delivered northern consuming centers are reported, with few takers.

◆ Chemicals

Bleaching powder is moving steadily to consumers, especially on contracts, and is quoted firmly at 2 to 2.25 cents a pound in drums f. o. b. works. Rosin prices are maintained, with papermaking rosin quoted at $7.87½ per 280 pounds in barrels f. o. b. producing points.

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Results here are: increase of storage capacity per total of ground area available, avoids re-handling, eliminates damaged stock losses - Vertical piling eliminates roll flattening.

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Import and Export MARKETS

IMPORTS

◆ Wood Pulp

The lull in wood pulp demand continues. If anything, it is more accentuated than at any time during the distinctly quiet spell of the past few months. Paper and board manufacturers are according very little attention to the acquisition of additional pulp supplies; from all indications and judging from their assertions they are amply supplied with pulp on hand and well provided with pulp contracted for and scheduled to be delivered over the next few months, and, dissatisfied with the development of conditions within their own markets, are keeping practically entirely out of evidence as pulp purchasers.

The market is dull indeed. Pulp importers and agents at New York candidly say they do not recollect so lengthy a period during which mill customers have refrained so completely from buying, and manifesting such slight interest in the offerings put before them. At the same time the market is possessed of a firm undertone, particularly as concerns sulphite pulp, with the kraft situation inclining toward easiness. This strength in sulphite is due to the very favorable position of producers abroad. Mills making sulphite, bleached or unbleached, are practically sold out for all of next year, and, having little or no tonnage to dispose of, are not seeking to sell and it would seem that a reduction in quotations is the farthest thing from their minds.

Foreign kraft pulp also is quotably maintained although, presumably as a result of the weakening situation in domestic kraft, there are signs of a potentially easier condition in imported kraft pulp. Producers abroad are also well sold up on kraft pulp, virtually all of next year's output having been contracted for, yet it appears feasible for buyers—if they care to go far enough ahead—to get some kraft supply in foreign sources at reduced price levels, possibly a forerunner of what is to come in this class of chemical wood pulp as an outcome of the tremendous increase in kraft production in the South.

Little if any prime bleached sulphite for shipment from abroad anytime in the next few months is available under 4.50 cents per pound ex dock American Atlantic ports. As a matter of fact, quotations seldom are below 4.75 to 5 cents, and some mills in Europe are said to be refusing to entertain anything less than a price of 5 cents. Unbleached sulphite for any near shipment from abroad is quoted at 3.50 cents or higher per pound for prime strong grades, ex dock American Atlantic seaboard, half prime quality at 3.35 to 3.50 cents, and prime easy bleaching at 3.75 to 4 cents. Prime Scandinavian kraft pulp is quoted at 3.50 cents, and more, for near shipment, down to about 3.10 or 3 cents for 1938 deliveries, ex dock basis at American Atlantic ports.

Imports of pulp into the United States in July last continued on a large scale although falling below the record-breaking tonnage received in the preceding month. Importations of chemical pulp of all grades totaled 202,136 short tons, air dry weight, valued at $8,846,698, according to U. S. Commerce Department figures, contrasted with 240,326 tons of a declared value of $10,136,997 in June this year, and 185,218 short tons of a value of $7,039,547 in July last year. The July receipts brought the aggregate for the first seven months of 1937 up to 1,276,365 short tons, compared with 1,115,646 tons in the same period a year ago, a gain this year of 160,710 tons, or 14.4 per cent.

Mechanical pulp imports in July amounted to 24,561 short tons of a value of $469,103, against 19,713 tons of a value of $401,100 in June last and 22,882 tons valued at $404,865 in July, 1936. Seven months' total this year reached 134,645 short tons, compared with 116,199 tons in the similar period of 1936. Figures for the first seven months seem to insure that a new high record of wood pulp importations into the United States will be established this year.

◆ Paper Stock

Imports of rags for papermaking during July were 22 per cent higher and imports of miscellaneous paper stock 14 per cent higher in volume than in the similar month a year ago. Imports of pulpwood were 7 per cent higher than in June and 16 per cent above the July, 1936, receipts. Total imports of paper base stocks in July, including pulpwood and wood pulp, were valued at $11,917,463, against $13,060,113 in the month preceding.

◆ Paper

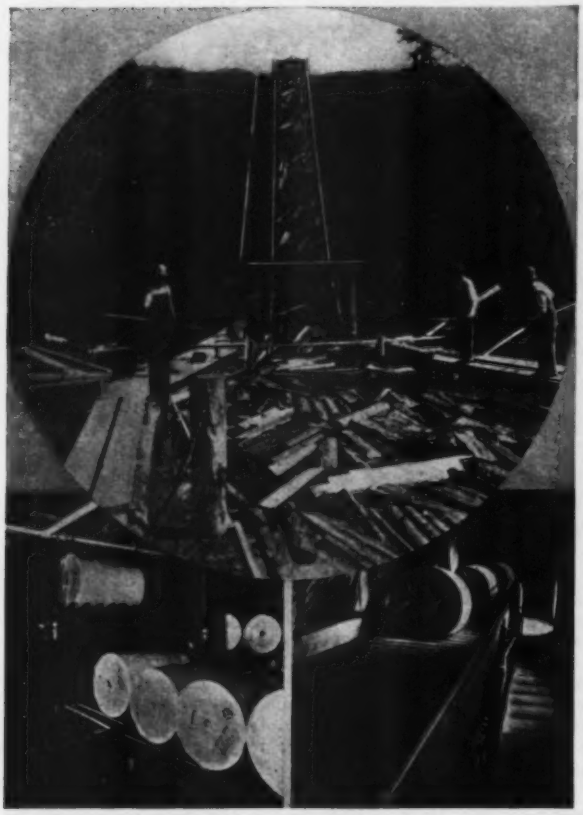
Imports of newsprint continue to show an upward trend. July receipts, which totaled 302,982 tons, according to U. S. Commerce reports, exceeded the preceding month's arrivals by 5 per cent, and those of the corresponding 1936 month by 47 per cent. Imports of a number of other classes of paper, including other printing papers, greaseproof and waterproof papers, lightweight tissues and kraft wrapping, also were higher than in the same month last year. Imports of cigarette papers, which usually rank next to newsprint in value, were 20 per cent higher than in June yet were slightly under the July, 1936, receipts. An increase took place in imports of pulpboards in rolls, which also recorded a rise over last year's importations. Imports of paper and paper products reached a total value of $12,489,330 in July, of which $11,246,265 represented newsprint, and $1,243,065 other papers and boards. Newsprint receipts showed an increase in value of 4 per cent over June and 55 per cent over July, 1936.

EXPORTS

Exports of paper and paper products from the United States during July reached an aggregate value of $2,639,486, according to figures issued by the U. S. Commerce Department. This represented an increase in value of 31 per cent over the same 1936 month, but was 6 per cent below the June, 1937, total. While a heavier volume of shipments in a majority of items on the paper schedule contributed to the July increase compared with a year ago, a large part of this year's gain was due to the large increases which occurred in shipments of such staple lines as newsprint, book papers, writing paper, paperboards, sheathing paper, bags and boxes.

Exports of newsprint again passed the 2,600-ton mark, exceeding the July, 1936, shipments by nearly 300 per cent. This was by far the largest gain in any one item. Exports of book paper were nearly 100 per cent and exports of writing paper 37 per cent higher than a year ago. Exports of miscellaneous wrapping papers dropped 20 per cent under the July, 1936, figure but this loss was offset by increases in shipments of kraft wrappings and paper bags. In the board group, boxboard shipments showed a rise of 31 per cent and other paperboards 70 per cent over last year. Sheathing and building papers were another item to register a rise of close to 100 per cent in exports as contrasted with a year ago. Exports of fibre insulating board, however, were only 5 per cent and wallboards only 15 per cent higher than in the corresponding 1936 month. Of the remaining items only surface-coated papers, greaseproof and waterproof papers and paper towels and napkins failed to reach or exceed last year's level, and only the first-mentioned grade showed an appreciable decrease. Exports of greaseproof and waterproof papers were only 3 per cent and exports of paper towels and napkins only 7 per cent under those recorded for July, 1936. Surface-coated paper shipments dropped 3 per cent under the June figure and nearly 25 per cent below the July, 1936, exports.

ADVERTISING PAGES REMOVED



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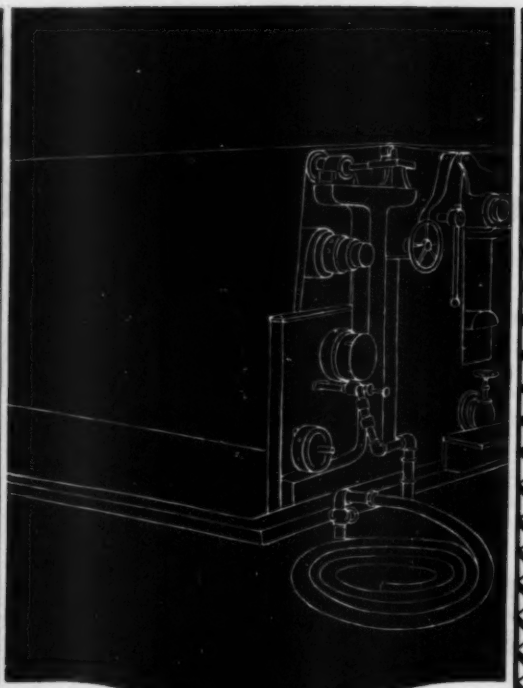

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